

Palynology and ostracode distribution in the Upper Devonian and basal Dinantian of Belgium and their dependence on sedimentary facies

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20 figures, 2 enclosures, 30 plates

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ABSTRACT

Bringing together information from sources as different as palynology, ostracodology and sedimentology in order to achieve a common paleoecological model for Upper Devonian and basal Dinantian strata in Belgium is the main purpose of the present paper. The usefulness of semiquantitative palynological data for biostratigraphical purposes in a relatively small area is confirmed. The average size of the spore as well the ostracode assemblages has been largely controlled by the energy-level of the sedimentary environment. Five acritarch assemblages (a, b, b', c and d), based on different relative frequencies of the same species, characterize intertidal to alluvio-lagoonal environments. Four ostracode assemblages (I, II, III and IV), based on different species and genera, characterize subtidal to supratidal environments.

RÉSUMÉ

Un essai est tenté de réunir des informations provenant de sources aussi différentes que la palynologie, l'ostracodologie et la sédimentologie pour mieux asseoir un modèle paléocéologique en commun pour le Dévonien supérieur et la base du Dinantien en Belgique. L'utilité de données palynologiques semi-quantitatives pour un but biostratigraphique dans les limites d'une aire relativement restreinte est confirmée. Cinq assemblages d'acritarches (a, b, b', c et d) fondés sur des différences relatives dans les fréquences des mêmes espèces caractérisent des environnements intertidaux à alluvio-lagunaires. Quatre assemblages d'ostracodes (I, II, III et IV) fondés sur des espèces différentes caractérisent des environnements subtidaux à supratidaux. La taille moyenne des assemblages de spores comme des assemblages d'ostracodes a été principalement affectée par les niveaux d'énergie de l'environnement sédimentaire.

1. INTRODUCTION

The main purpose of this paper is to show how far different disciplines of paleontology and sedimentology may complement each other in achieving a general understanding of the detailed history of a relatively small area. We have selected the Upper Famennian of the Ourthe valley as a test case because of the large amount of available data on micropaleontology and sedimentology. Moreover, several of the type and reference sections for the Upper Famennian are located in the Ourthe valley.

Once having constructed the paleoecological model for the Upper Famennian in this area, we may try to apply the same model on sediments and fossils of about the same age in adjacent areas.

We have accepted the biostratigraphic framework proposed by BOUCKAERT, STREEL & THOREZ (1968) as a datum. In addition, THOREZ (1969) has correlated the major sedimentary rhythms and different marker beds such as red beds with the biostratigraphic zones. The micropaleontological information in this paper covers an interval from Middle Frasnian to Middle Tournaisian with emphasis on the Upper Famennian data of the Ourthe valley, where a detailed sedimentological investigation has been carried out.

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3. OSTRACODES

(G. BECKER & M. J. M. BLESS)

The Upper Devonian and Lower Dinantian calcareous sediments of the Dinant and Namur Basins in Belgium have proven to contain an as yet only poorly known ostracode fauna consisting of several hundreds of species. In hardly four years, more than 200 species have been recovered by us (BECKER 1971; BECKER & BLESS 1971, 1974, this paper). Many of these are still undescribed because of insufficient material. It is expected that further investigations will yield an even larger number of species.

Therefore, it appears premature to give detailed descriptions as long as the first sampling of different locations has not been finished. Following the practice of our 1974-paper, we present species-lists for each location and have tried to figure as many specimens as possible to show variation within each species. Moreover, we continue to use open nomenclature for most species. An exception has been made for the genera "*Bernix*" and *Beyrichiopsis*, which are of some interest for long-distance correlations. Formal description of the other species will be presented in a future monograph.

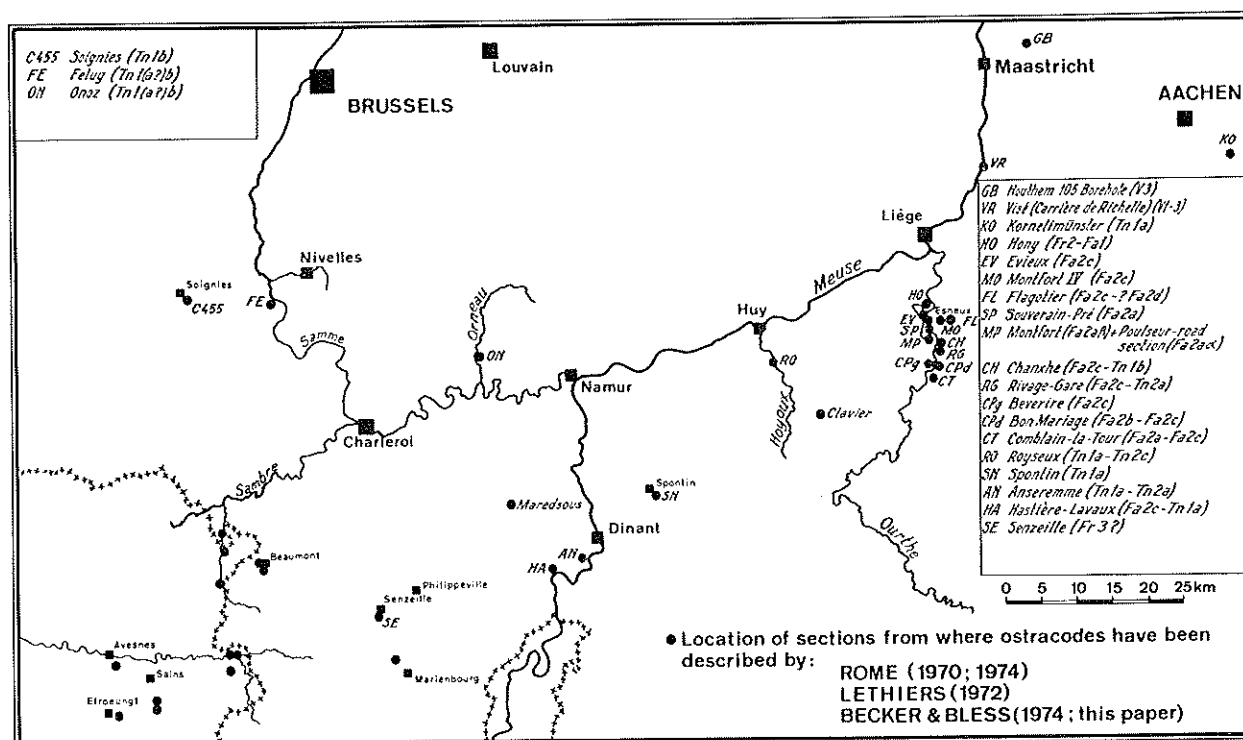


FIG. 1 — Location of Upper Devonian and Dinantian sections from where ostracodes have been described within the last five years

Fig. 1 shows the sample locations of some recent papers on Upper Devonian and Dinantian ostracodes in Belgium and adjacent areas of France, The Netherlands and Germany.

The ostracodes from the sections of Senzeille, Hony and Poulseur have been stored with the paleontological collections of the "Forschungs-Institut Senckenberg" (Frankfurt am Main) (specimens indicated with the symbols SMFXe...) and of the Geological-Paleontological Institute of the University of Frankfurt am Main. The ostracodes of all other sections have been deposited with the paleontological collections of the Geological Bureau of the Netherlands Geological Survey at Heerlen.

3.1. SPECIES-LISTS

3.1.1. SENZEILLE — Section about 500 m South of railway station of Senzeille along railroad Senzeille-Mariembourg; Fr2i (?transition to Fr3)

- SE41 *Hollinella* (*Keslingella*) sp. indet.
Kummerowia sp. 113
Punctomosea weyanti BECKER 1971
Bairdiocypris sp. indet.
Microcheilinella sp. A BECKER 1971
Bairdia (*Bairdia*) sp. 116
Bairdia (*Bairdia*) *fobosi* EGOROV 1953
sensu LETHIERS 1970
Orthocypris sp. indet.

Richterina (*Richterina*) *striatula*
REINH. RICHTER 1848
ostracode g. et sp. indet.

3.1.2. HONY — Railroad section (fig. 2); Fr2i-Fa1

- HO30 *Hollinella* (*Keslingella*) sp. 109
Moorites sp. 130
Uchtovia materni BECKER 1971
Polyzygia neodevonica (MATERN 1929)
Punctomosea weyanti BECKER 1971
ostracode sp., cf. *Bairdia* (*Bairdia*?) aff. *kelleri*
EGOROV in POLENOVA 1953
Cryptophyllus cf. sp. 17 BECKER & BLESS 1974
ostracode g. et sp. indet.
- HO31 beyrichiacean ostracode sp. 101
beyrichiacean? ostracode sp. 102
Adelphobolbina cf. *europaea* BECKER & BLESS 1971
Hollinella vel *Adelphobolbina* sp. 105
Parabolbinella vomis BECKER & BLESS 1971
Moorites sp. 130
Amphissites cf. *parvulus* (PAECKELMANN 1913)
Polytylites sp. 107
Uchtovia materni BECKER 1971
Hypotetragona tremula BECKER 1971
Polyzygia neodevonica (MATERN 1929)
Punctomosea weyanti BECKER 1971
ostracode sp., cf. *Bairdia* (*Bairdia*?) aff. *kelleri*
EGOROV in POLENOVA 1953
Cryptophyllus cf. sp. 18 BECKER & BLESS 1974
ostracode g. et sp. indet.
- HO32 *Cryptophyllus* sp. indet.
- HO39 beyrichiacean ostracode sp. 100
beyrichiacean ostracode sp. 103
Cryptophyllus sp. indet.
ostracode g. et sp. indet.

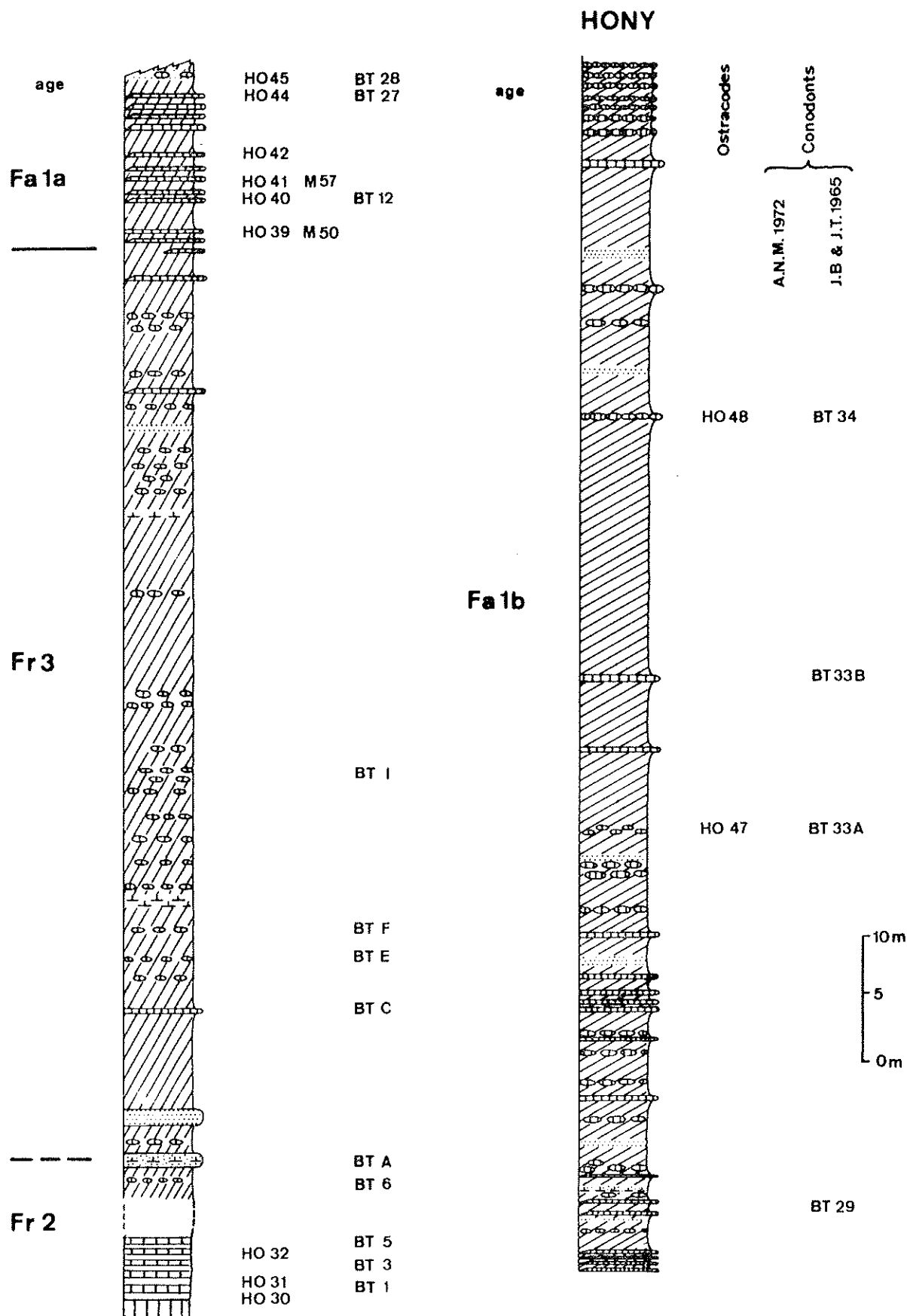


FIG. 2 — Middle Frasnian-Lower Famennian rocks in railroad section at Hony. Lithology by J. THOREZ

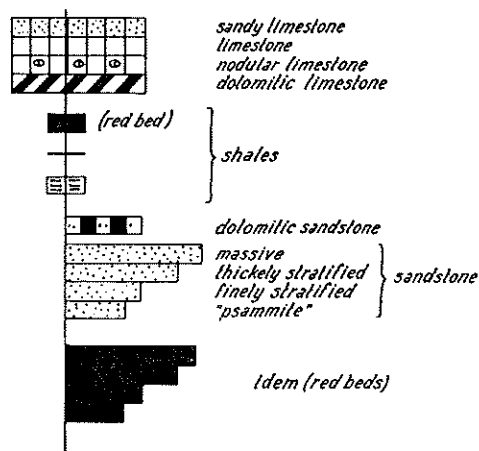


FIG. 3 — Legend to figures 3-10 and Spontin-Sources section on Enclosure I

- HO40 beyrichiacean ostracode sp. 100
beyrichiacean ostracode sp. 103
Ochescapha ? sp. 110
Glezeria belgica (MATERN 1929)
Hypotetragona ? sp. indet.
Bythocyproidea sp. indet.
"Cytherellina" sp. 131
Cryptophyllus cf. sp. 17 BECKER & BLESS 1974
ostracode g. et sp. indet.
- HO41 beyrichiacean ostracode cf. sp. 100
Knoxiella sp. 108
Knoxiella ? sp. 132
quasillitid ostracode sp. 112
"Cytherellina" sp. 131
Cryptophyllus cf. sp. 17 BECKER & BLESS 1974
Cryptophyllus cf. sp. 18 BECKER & BLESS 1974
ostracode g. et sp. indet.
- HO42 quasillitid ostracode sp. 112 ?
Cryptophyllus sp. 18 BECKER & BLESS 1974
ostracode g. et sp. indet.
- HO44 quasillitid ostracode sp. 112
ostracode g. et sp. indet.
- HO45 beyrichiacean ostracode sp. 104
Ochescapha ? *beckeri* GROOS 1969
Knoxiella ? sp. indet.
quasillitid ostracode sp. 112
podocopid ostracode sp. 106
ostracode g. et sp. indet.
- HO47 ostracode g. et sp. indet.
- HO48 beyrichiacean ostracode sp. 104
beyrichiacean ? ostracode sp. indet.
Moorites sp. 130
quasillitid ostracode sp. 112
Cryptophyllus sp. indet.

3.1.3. POULSEUR — Road section (fig. 4); Fa2aα

- MP13 beyrichiacean ostracode sp. 104
beyrichiacean ? ostracode sp. 102
(specimen lost d. prep.)
Knoxiella sp. 114
Punctomosea sp. 115
ostracode g. et sp. indet.
- MP14 beyrichiacean ostracode sp. 104
palaeocopid ostracode sp. indet.
Punctomosea sp. 115
ostracode g. et sp. indet.

- MP16 *Punctomosea* sp. 115
- MP19 beyrichiacean ? ostracode sp. indet.
Bairdiocypris aff. *rudolphi* (KUMMEROW 1939)
Microcheilinella sp. 117
Bairdia (*Bairdia*) sp. 116
Bairdia (*Rectobairdia*) cf. *passirathensis*
KUMMEROW 1953
Bairdiocypris ? cf. *quarziana*
(EGOROV in POLENOVA 1953)
Bairdiocypris irregularis (POLENOVA 1953)
Acratia aff. *supina* POLENOVA 1953
Acratia cf. *evlanensis* EGOROV in POLENOVA 1953
ostracode sp., cf. *Bairdia* (*Bairdia* ?) aff. *kelleri*
EGOROV in POLENOVA 1953
ostracode g. et sp. indet.
- MP20 *Bairdiocypris* aff. *rudolphi* (KUMMEROW 1939)
Bairdiocypris cf. sp. 32 BECKER & BLESS 1974
Bairdiocypris sp. indet.
Bairdia (*Bairdia*) sp. 116
Bairdia (*Rectobairdia*) aff. *povorinensis*
SAMOILOVA 1970
Cryptophyllus cf. *materni*
(BASSLER & KELLETT 1934)
ostracode g. et sp. indet.
- MP21 *Bairdia* (*Bairdia*) sp. 116
Acratia aff. *supina* POLENOVA 1953
ostracode g. et sp. indet.

3.1.4. COMBLAIN-LA-TOUR (fig. 5); Fa2a-c

- CT4 *Cryptophyllus* indet.
Knoxiella indet.
Indivisia aff. *variolata* ZANINA 1960
Cavellina sp. 34 BECKER & BLESS 1974
Podocopid ? ostracode indet.
- CT6 *Cavellina* sp. 34 BECKER & BLESS 1974
Cavellina aff. *coela* (ROME 1974)

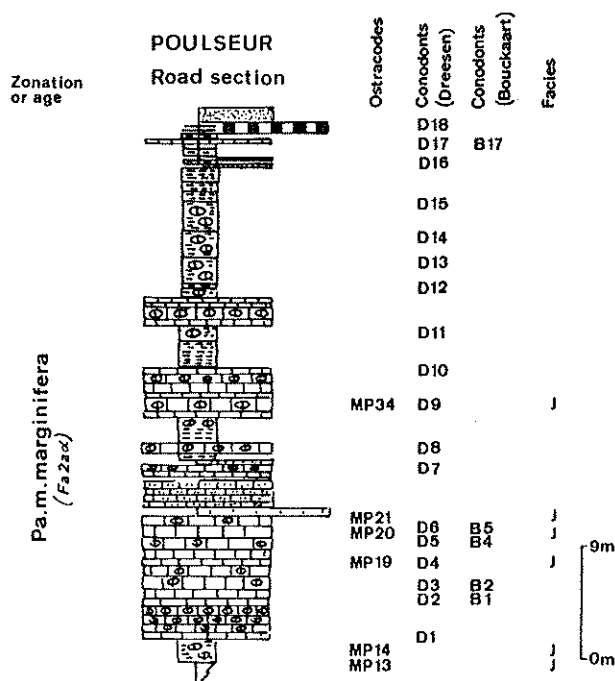


FIG. 4 — Part of basal Upper Famennian in road section near Poulseur. Lithology by J. THOREZ

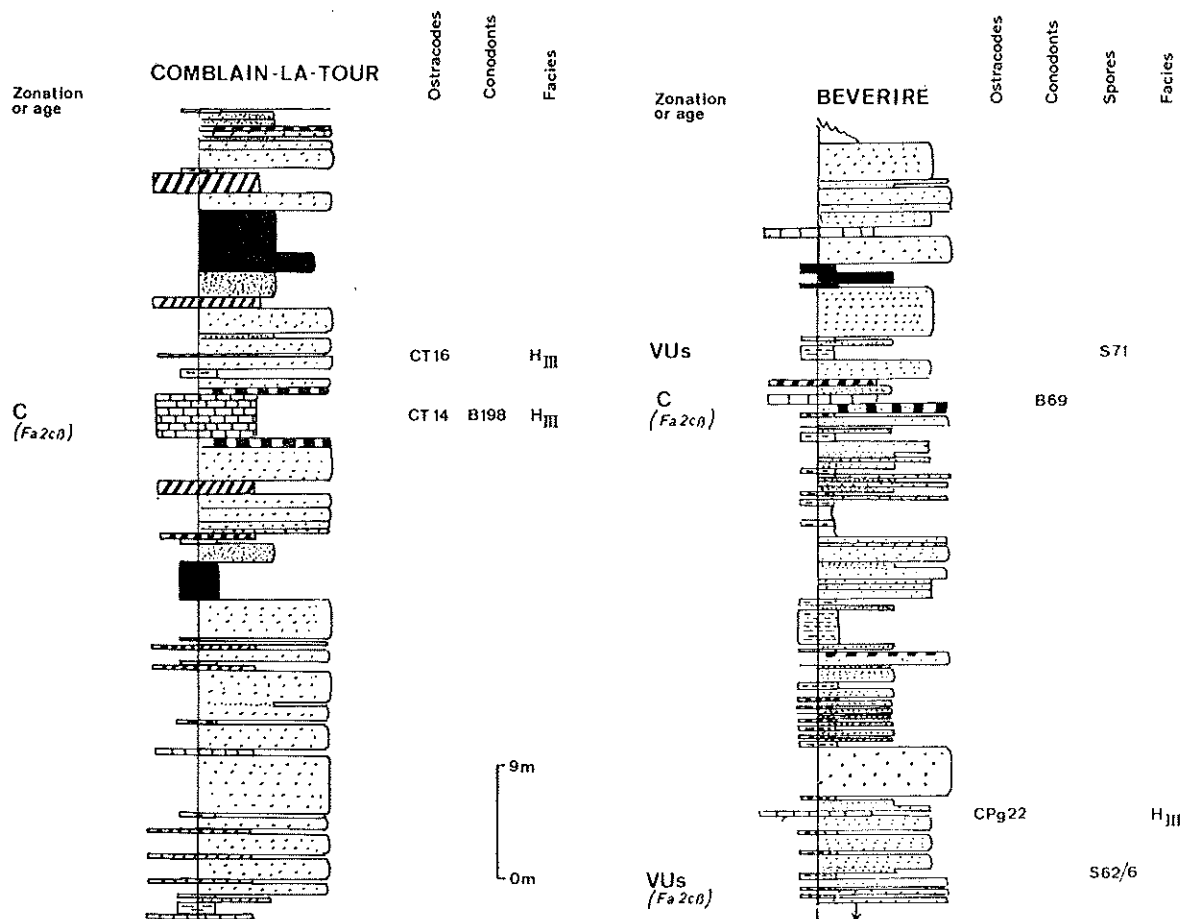


FIG. 5 — Part of Upper Famennian in abandoned quarry at Comblain-la-Tour. Lithology by J. THOREZ

- CT7 *Cryptophyllus* indet.
 CT14 *Cryptophyllus* indet.
Uchtovia sp. 86 (BECKER & BLESS 1974)
Cavellina aff. *coela* (ROME 1974)
Cavellina sp. 37 BECKER & BLESS 1974
 CT16 *Cryptophyllus* sp. 18 BECKER & BLESS 1974
Shemonaella sp. 65 BECKER & BLESS 1974
Beyrichiopsis glyptopleuroides GREEN 1963
Knoxiella sp. 49 BECKER & BLESS 1974
Knoxiella sp. 51 BECKER & BLESS 1974
Cavellina aff. *coela* (ROME 1974)

3.1.5. BEVERIRE (quarry on left bank of Ourthe South of Comblain-au-Pont) (fig. 6); Fa2c

- CPg18 *Knoxiella* indet.
Sulcella sp. 43 BECKER & BLESS 1974
Cavellina aff. *coela* (ROME 1974)
 Ostracode indet.
 CPg22 *Cryptophyllus* sp. 16 BECKER & BLESS 1974
Cryptophyllus sp. 18 BECKER & BLESS 1974
Shemonaella sp. 65 BECKER & BLESS 1974
Kloedenellitina alveolata TSCHIGOVA 1960
Knoxiella sp. 49 BECKER & BLESS 1974
Knoxiella sp. 50 BECKER & BLESS 1974
Knoxiella sp. 51 BECKER & BLESS 1974
Cavellina aff. *coela* (ROME 1974)

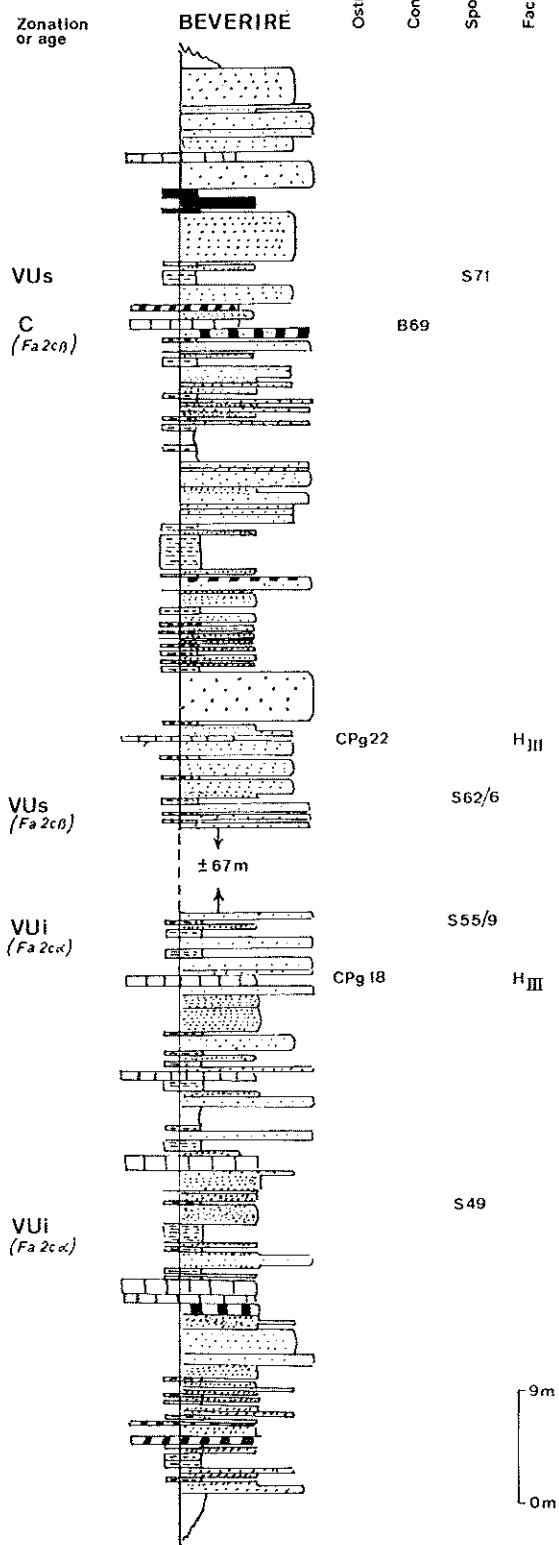


FIG. 6 — Upper Famennian in quarry of Beverire, immediately South of Comblain-au-Pont at left bank of river Ourthe. Lithology by J. THOREZ

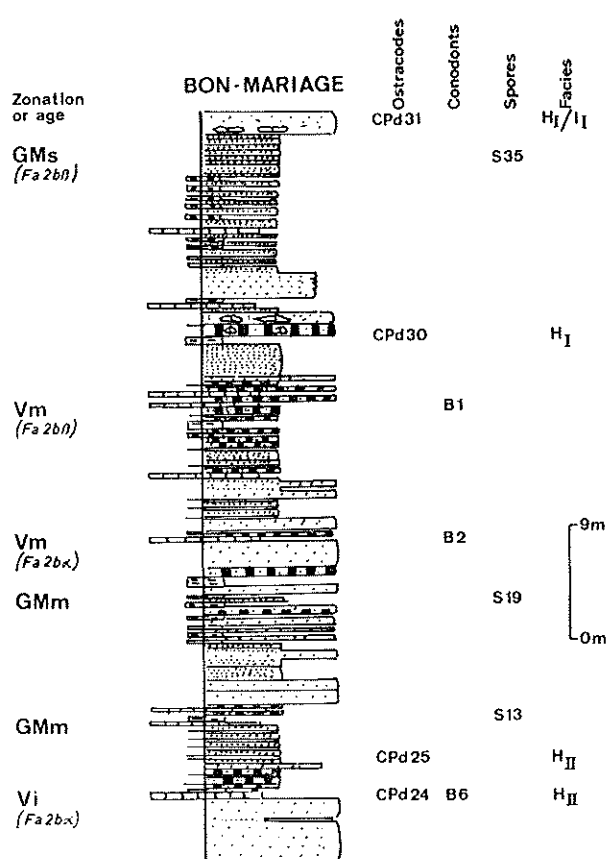


FIG. 7 — Upper Famennian in abandoned quarry Bon-Mariage along railroad South of Comblain-au-Pont at right bank of river Ourthe. Lithology by J. THOREZ

3.1.6. BON-MARIAGE (quarry on right bank of river Ourthe South of Comblain-au-Pont) (fig. 7); Fa2b-c

- CPd24 *Uchtovia* sp. 86 (BECKER & BLESS 1974)
Cavellina sp. 34 BECKER & BLESS 1974
- CPd25 *Cavellina* sp. 34 BECKER & BLESS 1974
- CPd30 *Cryptophyllus* indet.
Shemonaella? sp. 66 BECKER & BLESS 1974
Shivaella? sp. n. 72 BECKER & BLESS 1974
Beyrichiopsis? ostracode sp. 69 (BECKER & BLESS 1974)
Indivisia aff. *variolata* ZANINA 1960
Beyrichiopsis sp. 46 (BECKER & BLESS 1974)
Eulanella aff. *incognita* EGOROV in POLENOVA 1953
Cavellina sp. 34 BECKER & BLESS 1974
Cavellina aff. *coela* (ROME 1974)
Cavellina sp. 37 BECKER & BLESS 1974
Podocypid ostracode indet.
- CPd31 *Cryptophyllus* sp. 16 BECKER & BLESS 1974
Knoxiella indet.
Sulcella sp. 43 BECKER & BLESS 1974
Cavellina sp. 34 BECKER & BLESS 1974
Cavellina aff. *coela* (ROME 1974)
- CPd33 *Cavellina* aff. *coela* (ROME 1974)

3.1.7. RIVAGE-GARE — Railroad section (fig. 8); Fa2cβ

- RG13 *Cryptophyllus* indet.
Shemonaella sp. 65 BECKER & BLESS 1974

Beyrichiopsis glyptopleuroides GREEN 1963
Knoxiella sp. 49 BECKER & BLESS 1974
Knoxiella sp. 51 BECKER & BLESS 1974
Cavellina aff. *coela* (ROME 1974)

3.1.8. CHANXHE — Approach to quarry of Richopré (fig. 9 and enclosure I); Fa2cβ-Tnlby

- CH5 *Cryptophyllus* sp. 17 BECKER & BLESS 1974
Cryptophyllus sp. 18 BECKER & BLESS 1974
Knoxiella indet.
Sulcella sp. 44 BECKER & BLESS 1974
Cavellina aff. *coela* (ROME 1974)
- CH6 *Cryptophyllus* sp. 17 BECKER & BLESS 1974
Cryptophyllus sp. 18 BECKER & BLESS 1974
Shemonaella? sp. 66 BECKER & BLESS 1974
Ochescapha rara (TSCHIGOVA 1958) (= species 67 BECKER & BLESS 1974)
Beyrichiopsis sp. 47 (BECKER & BLESS 1974)
Knoxiella sp. 51 BECKER & BLESS 1974
Sulcella sp. 44 BECKER & BLESS 1974
- CH8 *Cryptophyllus* sp. 17 BECKER & BLESS 1974
Sulcella sp. 44 BECKER & BLESS 1974
- CH11 *Cryptophyllus* sp. 16 BECKER & BLESS 1974
Cryptophyllus sp. 18 BECKER & BLESS 1974
Shemonaella sp. 65 BECKER & BLESS 1974
Bouchekius cf. *rotundus* ROZHDESTVENSKAJA 1972
Beyrichiopsis glyptopleuroides GREEN 1963
Knoxiella sp. 50 BECKER & BLESS 1974
Knoxiella sp. 51 BECKER & BLESS 1974
- CH12 *Cryptophyllus* sp. 17 BECKER & BLESS 1974
Cryptophyllus sp. 18 BECKER & BLESS 1974
Shemonaella sp. 65 BECKER & BLESS 1974
Shemonaella? sp. 66 BECKER & BLESS 1974
Knoxiella indet.
Cavellina aff. *coela* (ROME 1974)

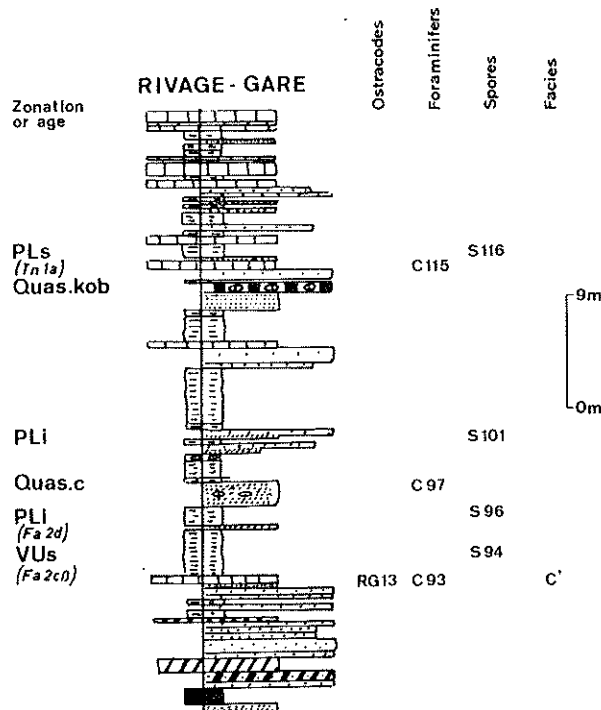
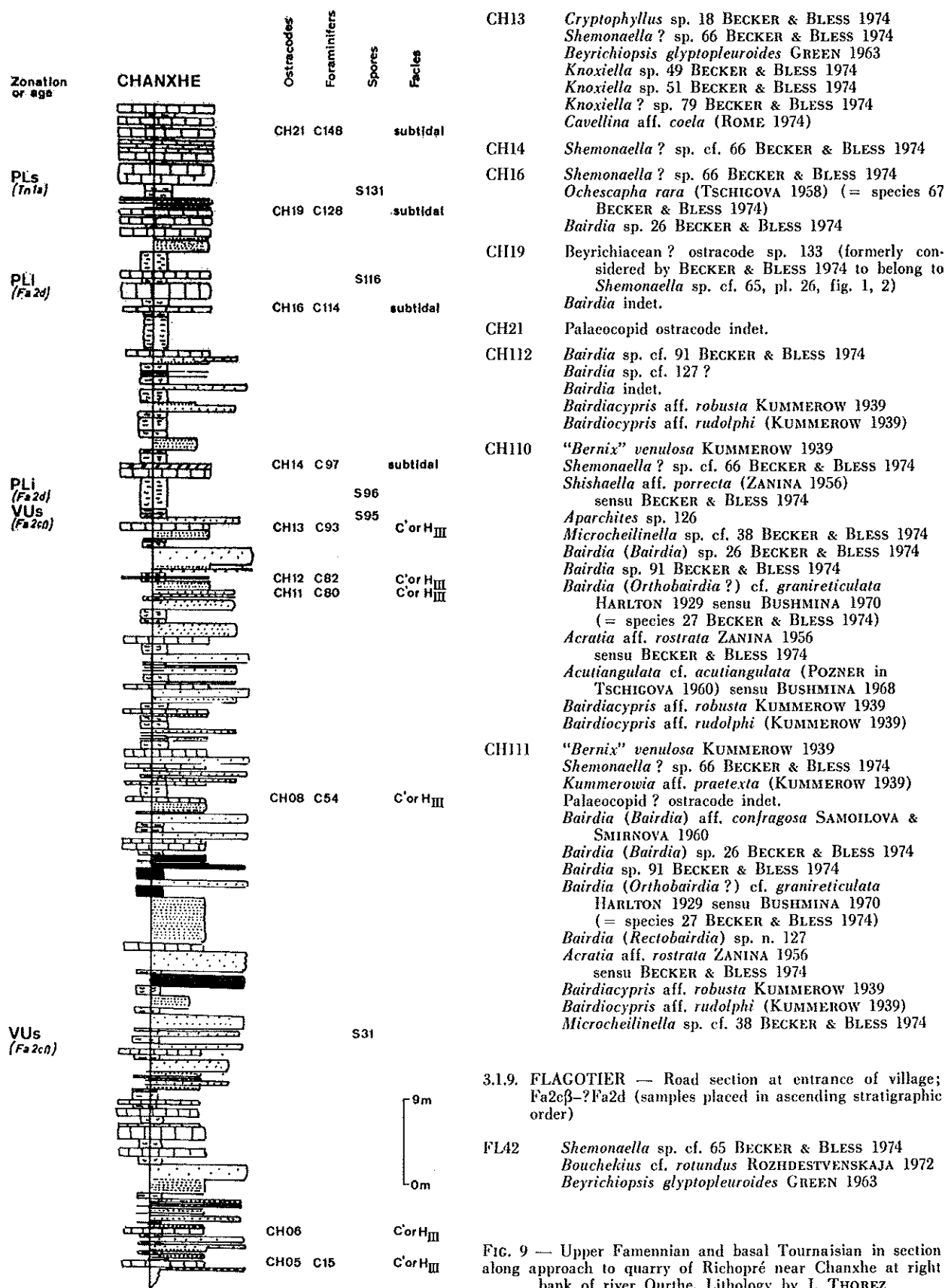


FIG. 8 — Part of Upper Famennian in railroad section at Rivage-Gare. Lithology by J. THOREZ



- FL40 *Knoxiella* sp. 49 BECKER & BLESS 1974
Sulcella sp. 44 BECKER & BLESS 1974
Uchiovina sp. 86 (BECKER & BLESS 1974)
Cavellina aff. *coela* (ROME 1974)
Bairdia (*Cryptobairdia*) sp. 128 aff. *singularis* KRÖMMELBEIN 1954
- FL39 *Amphissites* indet.
Bairdiid ? ostracode indet.
- Samples FL42 and FL40 are separated by a so-called "banc rouge" (red band), which may be correlated with similar red bands in the Chanxhe-section in between samples S31 and C54. This indicates a Fa2c β -age. Sample FL39 is probably of Fa2d-age.

- EV3 *Knoxiella* sp. 49 BECKER & BLESS 1974
Sulcella sp. 44 BECKER & BLESS 1974
Monoceratina sp. 118
Cavellina aff. *coela* (ROME 1974)
Cryptophyllus sp. 17 BECKER & BLESS 1974
Beyrichiacean ? ostracode sp. 69 (BECKER & BLESS 1974)
Beyrichiacean ? ostracode sp. 70 (BECKER & BLESS 1974)
Dorsoobliquella sp. n. 64 BECKER & BLESS 1974
Knoxiella sp. 49 BECKER & BLESS 1974
Cavellina aff. *coela* (ROME 1974)
- EV1 *Cryptophyllus* sp. 17 BECKER & BLESS 1974
Sulcella sp. 44 BECKER & BLESS 1974
Cavellina aff. *coela* (ROME 1974)

3.1.10. MONTFORT IV — Abandoned quarry; Fa2c β
(samples are placed in ascending stratigraphic order)

- MO35 *Cavellina* cf. *coela* (ROME 1974)
- MO38 *Cryptophyllus* sp. 16 BECKER & BLESS 1974
Cryptophyllus sp. 17 BECKER & BLESS 1974
? *Bouchekius* cf. *rotundus* ROZHDESTVENSKAJA 1972
Cavellina aff. *coela* (ROME 1974)

3.1.11. EVIEUX — Lower part of section (samples EV31–EV30) in abandoned quarry "Carrière de la grotte", upper part along railroad (fig. 10)

- EV31 *Cryptophyllus* sp. 17 BECKER & BLESS 1974
Cryptophyllus sp. 18 BECKER & BLESS 1974
Shemonaella ? sp. 66 BECKER & BLESS 1974
Beyrichiopsis glyptopleuroides GREEN 1963
Knoxiella sp. 49 BECKER & BLESS 1974
Knoxiella sp. 50 BECKER & BLESS 1974
Knoxiella cf. sp. 51 BECKER & BLESS 1974
Cavellina aff. *coela* (ROME 1974)
- EV32 *Cryptophyllus* sp. 16 BECKER & BLESS 1974
Cryptophyllus sp. 17 BECKER & BLESS 1974
- EV33 *Cryptophyllus* sp. 17 BECKER & BLESS 1974
Cryptophyllus sp. 18 BECKER & BLESS 1974
Shemonaella ? sp. 66 BECKER & BLESS 1974
Dorsoobliquella sp. n. 64 BECKER & BLESS 1974
Beyrichiopsis glyptopleuroides GREEN 1963
Beyrichiopsis sp. 47 (BECKER & BLESS 1974)
Knoxiella sp. 49 BECKER & BLESS 1974
Knoxiella cf. sp. 50 BECKER & BLESS 1974
Sulcella sp. 44 BECKER & BLESS 1974
Monoceratina sp. 118
Cavellina aff. *coela* (ROME 1974)
- EV28 *Cryptophyllus* sp. 17 BECKER & BLESS 1974
Knoxiella sp. indet.
Sulcella sp. 44 BECKER & BLESS 1974
Cavellina aff. *coela* (ROME 1974)
- EV29 *Cryptophyllus* sp. 16 BECKER & BLESS 1974
Cryptophyllus sp. 17 BECKER & BLESS 1974
Cryptophyllus sp. 18 BECKER & BLESS 1974
Shemonaella ? sp. 66 BECKER & BLESS 1974
Beyrichiopsis glyptopleuroides GREEN 1963
Beyrichiopsis sp. 47 (BECKER & BLESS 1974)
Knoxiella sp. 49 BECKER & BLESS 1974
Knoxiella sp. 50 BECKER & BLESS 1974
- EV30 *Cryptophyllus* sp. 17 BECKER & BLESS 1974
Cryptophyllus sp. 18 BECKER & BLESS 1974
Shemonaella ? sp. 66 BECKER & BLESS 1974
Beyrichiopsis glyptopleuroides GREEN 1963
Beyrichiopsis sp. 47 (BECKER & BLESS 1974)

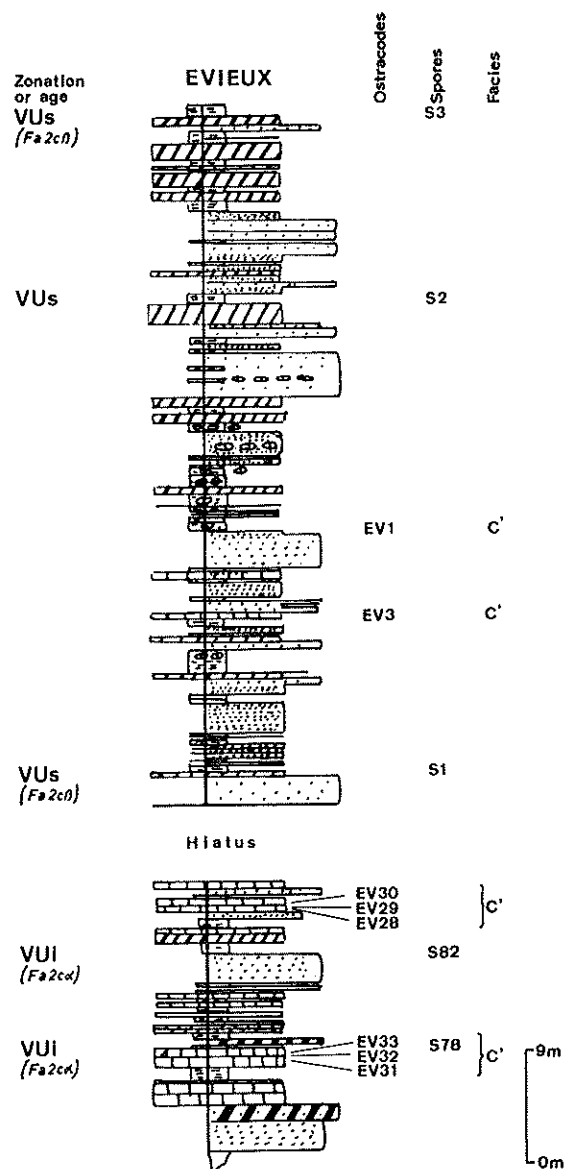


FIG. 10 — Upper Famennian in abandoned quarry "Carrière de la Grotte" (lower part of section) and in railroad section (upper part of section) at Evieux. Lithology by J. THOREZ

3.1.12. SPONTIN — Section along parking at entrance of mineral water factory "Sources de Spontin" (Enclosure I)

- SN1 *Hollinella* (*Keslingella*) sp. 53
BECKER & BLESS 1974
Shishaella aff. *porrecta* (ZANINA 1956)
sensu BECKER & BLESS 1974
Uchtovia sp. 86 (BECKER & BLESS 1974)
Knoxiella sp. 125
Palaeocopid ? ostracode sp. 124
Palaeocopid ? ostracode indet.
Acutiangularata cf. *acutiangularata* (POZNER in
TSCHIGOVA 1960) sensu BUSHMINA 1968
Bairdiid ostracode sp. 121
Bairdia (*Bairdia*) sp. 119
Bairdia (*Bairdia*) sp. 122
Bairdia (*Bairdia*) sp. 123
Bairdia (*Rectobairdia*) sp. 120
Bairdiocypris aff. *rudolphi* (KUMMEROW 1939)
Podocopid ostracode indet.

3.1.13. SOIGNIES — (section 455 along the Senne of CONIL, 1959, further referred to as C455/...; samples placed in ascending stratigraphic order)

- C455/13 *Shemonaella* ? cf. sp. 66 BECKER & BLESS 1974
Knoxiella cf. *rugulosa* (KUMMEROW 1939)
Knoxiella indet.
Hypotetragona cf. *cratigera* (JONES & KIRKBY 1886)
Cavellina coela (ROME 1974)
Microcheilinella inversa ROME 1971
C455/15 *Shemonaella* ? cf. sp. 66 BECKER & BLESS 1974
Pseudobythocypris planoventralis ROME 1971
C455/18 *Pseudobythocypris planoventralis* ROME 1971
Cavellina coela (ROME 1974)
C455/19B *Shemonaella* ? sp. 66 BECKER & BLESS 1974
Pseudobythocypris planoventralis ROME 1971
C455/21 *Shemonaella* ? cf. sp. 66 BECKER & BLESS 1974
Pseudobythocypris planoventralis ROME 1971
C455/29 *Pseudobythocypris planoventralis* ROME 1971
C455/34 *Shemonaella* ? cf. sp. 66 BECKER & BLESS 1974
Knoxiella cf. *complanata* (KUMMEROW 1939)
Knoxiella cf. *rugulosa* (KUMMEROW 1939)
Knoxiella indet.
Pseudobythocypris planoventralis ROME 1971
Microcheilinella inversa ROME 1971

3.2. SYSTEMATICS

Genus *BEYRICHIOPSIS* JONES & KIRKBY 1886

TYPE-SPECIES: *Beyrichiopsis fimbriata* JONES & KIRKBY 1886.

ORIGINAL DIAGNOSIS (JONES & KIRKBY 1886, Quart. Journ. Geol. Soc. London, 42, p. 506): "Valves shaped and lobed much like those of some *Beyrichiae*, but bearing longitudinal riblets, as in some *Kirbyae*. One of these ribs forms a dorsal crest; there is also a denticulate, spinose, or delicate fringe along the free margin. These characteristic features are well seen in *Beyrichiopsis fimbriata*".

REMARKS: The genus contains several small, straight-backed, bilobate or trilobate palaeocopid species with slight overlap of RV over LV; one or more elongate crests are present. The marginal fringe may be extremely delicate and depending on methods of preparation, the carapace may exhibit only a small crest along its margins or no velate structure at all.

POZNER in GUREVICH, 1966, erected a new genus *Glyptolichvinella* for a number of ostracode species, which apparently differ from *Beyrichiopsis* in the absence of a marginal fringe but exhibiting similar crests as in the latter genus.

Finally, some species assigned to the genus *Glyptopleura* by American and Russian ostracodologists, may as well belong to "frill-less" *Beyrichiopsis*.

Beyrichiopsis glyptopleuroides GREEN 1963

Pl. 6, figs. 1-6, 8-10

? *Glyptolichvinella chovanensis* POZNER — SAMOILOVA 1951, publication not seen.

Beyrichiopsis glyptopleuroides GREEN 1963, p. 99-102, pl. 4, figs. 2, 3, 5-11.

Beyrichiopsis sp. aff. *B. glyptopleuroides* GREEN 1963, p. 102, pl. 4, figs. 12, 13, 16.

Glyptolichvinella ? aff. *chovanensis* POZNER (in litt.) — GUREVICH 1966, p. 38, pl. 2, figs. 3-5.

Beyrichiopsis anulata ROME 1971, Mém. Instit. Géol. Univ. Louvain, XXVII (1), pp. 14-16, figs. 11-14.

Glyptolichvinella aff. *chovanensis* sensu GUREVICH 1966 — BECKER & BLESS 1974, pl. 28, figs. 1-7.

MATERIAL: About 60 single valves and complete carapaces from six locations (Comblain-la-Tour, Rivage-Gare, Chanxhe, Flagotier, Evieux, Feluy).

STRATIGRAPHIC DISTRIBUTION: Fa2c (Ourthe valley) — Tn1b? (Feluy).

DIAGNOSIS: A species of *Beyrichiopsis* with a single U-shaped to annular lateral crest, an incomplete submarginal crest along dorsal and ventral borders and a finely striate marginal frill, which is usually entirely broken from the carapace. Lateral surface finely or coarsely reticulate. Indistinct shallow S_2 crossed by dorsal limb of lateral crest.

Dimorphism presumably present. One dimorph having an essentially finely reticulate surface, the other having a coarsely reticulate surface in the area enclosed by the lateral annular crest, the area between the crest and the submarginal crest being either finely punctate or smooth.

DIMENSIONS:

greatest length (without marginal frill): 1.1 mm
greatest height (without marginal frill): 0.7 mm

DISCUSSION: Both juvenile and adult specimens have been observed. They fit rather well with the description of *Beyrichiopsis glyptopleuroides* GREEN 1963 from the Banff Formation of Alberta, Canada and *Beyrichiopsis anulata* ROME 1970 from the Tn1b? of Feluy. Some of our specimens come, in fact, from ROME's

type-location. They fit in practically all details with the description of *Glyptolichwinella*? (sic!) aff. *chovanensis* POZNER in GUREVICH 1966. The latter is stated to have no marginal frill. But as shown in our own material, this frill may be completely broken off. Also ROME (1970) reported no frill in this species. GUREVICH's specimens came from the Torchin suite, Volyn and Lvov areas, U.S.S.R.

OCCURRENCE: This species has been recognized in relatively fine grained dark limestones with abundant other ostracodes belonging to the genera *Cryptophyllus*, *Shemonaella* (?), *Knoxiella* and *Cavellina*.

The species may be of some interest for long distance correlations since it is restricted as far as known to uppermost Famennian and lowermost Dinantian in the U.S.S.R., Belgium and Canada. The influence of environment on the vertical and lateral distributions of *B. glyptopleuroides* has been clearly demonstrated in Belgium.

Beyrichiopsis sp. 47 (BECKER & BLESS 1974)

Pl. 6, figs. 12, 13

Glyptolichwinella sp. 47 BECKER & BLESS 1974, pl. 28, fig. 8.

MATERIAL: About 10 single valves and complete carapaces from two locations (Chanxhe, Evieux).

STRATIGRAPHIC DISTRIBUTION: Fa2c (Ourthe valley).

DIAGNOSIS: Similar to *B. glyptopleuroides* with U-shaped to annular lateral crest, but having a completely smooth lateral surface. No marginal frill has been observed, but this may have been broken off. The S_2 is largely obscured and only visible as a faint shadow.

Dimensions of specimen EV30a-44: length 0.7 mm
height 0.45 mm

REMARKS: *B. sp. 47* has been only recognized in four samples at Chanxhe and Evieux. In the three samples at Evieux it is associated with *B. glyptopleuroides*. At Chanxhe it is not. *B. glyptopleuroides* occurs in six more samples without *B. sp. 47* at Comblain-la-Tour, Rivage-Gare, Chanxhe, Flagotier and Feluy. On first hand, one might believe that *B. sp. 47* represents badly preserved specimens of *B. glyptopleuroides*. Close examination of the specimens at Evieux learns, however, that there are no intermediate forms between the finely reticulate to pitted dimorphs in *B. glyptopleuroides* and the completely smooth *B. sp. 47* with its obscured S_2 and less well developed lateral crest. Therefore, we feel that *B. sp. 47* is a species in its own right.

Beyrichiopsis sp. 47 may be compared with *Glyptoleura parvacostata* GEIS, 1932 from the Salem Limestone (Lower Viséan) of Indiana (U.S.A.). These two species are to be distinguished apparently by the more prominent sulcus in the latter. No mention has been made of the occurrence of a marginal frill in *G. parvacostata*.

OCCURRENCE: *B. sp. 47* occurs in fine grained dark limestones with *B. glyptopleuroides*, *Sulcella* sp. 44, *Knoxiella*, *Cryptophyllus* and *Shemonaella* ?.

Beyrichiopsis sp. 46 (BECKER & BLESS 1974)

Pl. 6, fig. 7

Glyptolichwinella sp. 46 BECKER & BLESS 1974, pl. 28, fig. 8.

MATERIAL: One single left valve.

STRATIGRAPHIC DISTRIBUTION: Fa2b.

DIAGNOSIS: Similar to *B. glyptopleuroides*, but lateral ornament consisting of short striae subparallel to dorsal and ventral margins.

BEYRICHIACEA MATTHEW 1886

During the preparation of the ostracode material dealt with in this paper it became clear that a considerable part of the species recovered from the Hony and Poulseur sections should be assigned to a rather specialized group (or groups) of Beyrichiacea. Scattered Beyrichiacean ostracodes occur also in other sections at Evieux, Flagotier, Comblain-au-Pont, Chanxhe and Anseremme.

Practically without exception, these ostracodes can be only assigned to the Beyrichiacea because of the presence of an anteroventral inflation in the heteromorph. In some species, the velar bend is largely obscured or even absent. Only one species (species 104) shows a rather reduced lobation. An adductorial ridge can be usually observed in the interior, but is not reflected in an outer adductorial sulcus. Finally, many of these species are clearly unequivocal. During our first study of Famennian and Dinantian ostracodes from Belgium (BECKER & BLESS 1974) we assigned practically all such ostracodes to the Paraparchitacea, including *Shemonaella*. Now, after having observed many more typical beyrichiacean forms from the Frasnian and Lower Famennian and after having studied ROZHDESTVENSKAJA's 1972-paper, where she described similar unornamented beyrichiacean forms from the Upper Devonian of Bashkiria, we feel that several beyrichiacean ostracodes may still be hidden amongst our "paraparchitacean" material. The lack of large collections of both heteromorphs and tecnomorphs makes it impossible, however, to decide already at this moment whether most of these specimens are true beyrichiaceans or not. In some cases, extreme simplification of the beyrichiacean carapace may even result in forms gradually grading into other non-beyrichiacean groups. An example of the latter is apparently "*Bernix*" *venulosa* KUMMEROW 1939.

This simplification of the beyrichiacean carapace must have started rather early in history. MARTINSSON (1963) described this development in *Kloedenia* and *Saccarchites*. ADAMCZAK (1968) described a simplified genus from the Middle Devonian of Poland under the

name *Arikloedenia*. The latter may as well turn out to be the ancestor of "*Bernix*" *venulosa*. ROZHDESTVENSKAJA (1972) assigned several genera as *Saccarchites*, *Ochescapha*, *Phlyctiscapha*, *Aparchites*, *Aparchitellina* and three new genera *Bouchekius*, *Copelandites* and *Reversoscapha* to the same family *Aparchitidae*, removing them from the true beyrichiacean ostracodes. It is noteworthy that the paraparchitacean ostracodes start at about the time that the beyrichiacean/aparchitacean ostracodes disappear at the Devonian-Carboniferous boundary.

Accepting MARTINSSON's (1962; 1963) hypothesis that these simplified beyrichiacean genera may have evolved from different stocks within the *Beyrichiidae* s.s. and *Craspedobolbinidae* s.s., the group of *Aparchitacea* sensu ROZHDESTVENSKAJA and *Paraparchitacea* sensu SCOTT 1961 (in MOORE, ed., 1961) and SOHN 1971 may as well represent polyphyletic groups evolved from these early beyrichiacean ostracodes, in which lobation and adventral dimorphic structures have become more and more obscured and other characters as posteroventral inflation, calcification of inner lamella and prominent overlap became more and more common. Further study on large collections should prove this.

For the time being, we may refer to a rather contradictory example of to what extremes these evolution may have gone in "*Bernix*" *venulosa*.

"*Bernix*" *venulosa* KUMMEROW 1939

Fig. 11; pl. 11, figs. 1-3; pl. 12, figs. 1-7

Bernix venulosa KUMMEROW 1939, Abh. Preuss. Geol. Landesanst., N.F. 194, p. 26, pl. 3, fig. 1a-c.

? *Pseudoleperditia poolei* SOHN 1969, U.S. Geol. Surv. Prof. Pap. 643-C, p. C4-C5, pl. 1, figs. 1-35.

"*Bernix*" *venulosa* KUMMEROW — BECKER & BLESS 1974, pl. 40, figs. 1, 2.

MATERIAL: About 60 single valves and 3 complete carapaces from four locations (Anseremme, Royseux, Rivage-Gare, Chauxhe).

STRATIGRAPHIC DISTRIBUTION: Tn1b (— Lower Viséan?).

DIAGNOSIS: Large straight-backed subrectangular ostracodes with narrow sulcus at about midlength and a low, subdued lobe in front of it; surface with scattered punctae which show a peculiar radiating arrangement from the base of the sulcus; drop-shaped muscle scar may be seen on the interior of the valves at the base of the sulcus, in some specimens its position being reflected on the exterior of the valves; interior of valves may at least in part bear a network of anastomosing venose lines, which appear to depart from the muscle scar area; near the posterodorsal angles of both valves a single large spine exists of which only the base could be preserved during preparation of the present material; a small-sized spine has been observed on the anterodorsal angle of the right valve.

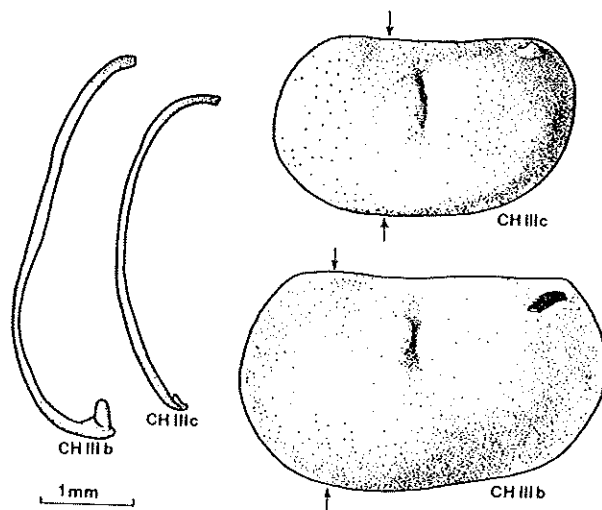


FIG. 11 — "*Bernix*" *venulosa* KUMMEROW 1939. CH111b: female LV; arrows indicate position of thin section. CH111c: male LV; arrows indicate position of thin section. Thin sections also figured on plate 12, figs. 1 and 2

Thin sections show a well-developed inner lamella; this inner lamella is also observed in some specimens (pl. 12, figs. 1, 2) along the free margins; at the junction of inner and outer lamella a pore-like structure has been observed in thin section (pl. 12, fig. 1b). Dimorphism present, consisting of an inflated anteroventral area in the heteromorphs; the interior of this inflated area is smooth in contrast to the other part of the valves, where the venose line network ornament occurs (pl. 11, fig. 2).

Hingement apparently of groove-and-ridge type (pl. 12, fig. 2b).

DIMENSIONS:

greatest length (tecnomorphs) :	3.2 mm
greatest length (heteromorphs) :	4.0 mm
greatest height (tecnomorphs) :	2.0 mm
greatest height (heteromorphs) :	2.4 mm

DISCUSSION: Both juvenile and adult specimens have been observed. They fit in all details with the description of *Bernix venulosa* from the Lower Tournaisian of Belgium (Insemont, Hastière limestone = Tn1b) and Federal Republic of Germany (Ratingen, dark limestone of ostracode limestones). *Pseudoleperditia poolei* SOHN 1969 from the Narrow Canyon Limestone and lower Mercury Limestone (Kinderhookian) of Nevada (U.S.A.) is also very similar, the principal difference being its smaller measured size for heteromorphs (length max. 2.52 mm). However, SOHN (1969, p. C4) stated that fragments of larger specimens had been observed. *Pseudoleperditia tuberculifera* SCHNEIDER 1956 from the Tournaisian of the NE Russian Platform is distinctly smaller and the sulcus and lobe appear to be situated lower on the valves than in our specimens. However, it is not impossible, that

SCHNEIDER (1956) figured a slightly misshaped juvenile *tecnomorph*. TSCHIGOVA (1967, table 9) noted *Pseudoleperditia* from the Turgenev to Malevka (Upper Famennian–Lower Tournaisian) of the Russian Platform. According to KUMMEROW (1939) *Bernix venulosa* occurs also in the Lower Viséan rocks of Horion-Hozémont (Belgium). This latter occurrence has not been checked yet. KUMMEROW compared his species with *Bernix tatei* (JONES 1864) from the Carboniferous Limestone (Upper Viséan) of Northumberland. Although SHAVER (in MOORE, ed., 1961, p. Q412) stated, that JONES' original specimens are unrecognizable, it is not impossible, that *Bernix tatei* (JONES) and *Bernix venulosa* KUMMEROW represent the same genus. In that case, *Pseudoleperditia* SCHNEIDER would become a synonym of *Bernix*.

A most fascinating problem is the presence in "*Bernix*" *venulosa* (including *Pseudoleperditia poolei*) of a presumable inner lamella, which has been observed by SOHN in the American specimens and now by us in the Belgian material. If we accept the classification of ostracodes in the Treatise on Invertebrate Paleontology (MOORE, ed., part Q) as still valid, this species (either belonging to *Bernix* or to *Pseudoleperditia*) is no true palaeocopid. The same holds for some other "palaeocopid" genera such as *Geisina*. The interior network of venose lines parting from the muscle scar and the pitted outer surface are characters known from many leperditicopid genera, such as *Anisochilina* TEICHERT 1937 and *Schrenckia* GLEBOVSKAIA 1949. Also the drop shape of the muscle scar is a leperditicopid rather than a palaeocopid character. Our "inner lamella" may as well be a structure homologous to the restricted inner layer observed in e.g. *Isoschilina*. Of course, the presence of a well developed and unmistakable sulcus is less characteristic of this order, nor are the dimorphic features.

OCCURRENCE: "*Bernix*" *venulosa* has been recognized in relatively coarse, bioclastic limestones with abundant foraminifers and echinoderm debris. Ostracodes associated with this species generally belong to *Bairdia*, *Bairdiocypris*, *Bairdiocypris* and *Shemonaella*.

The group of closely related — if not identical — species "*Bernix*" *venulosa* — *Pseudoleperditia poolei* — *P. tuberculifera* may be of some interest for long distance correlations since these ostracodes have all been described from lowermost Dinantian rocks in U.S.A. (SOHN 1969), Belgium (BECKER & BLESS 1974; this paper), Federal Republic of Germany (KUMMEROW 1939) and U.S.S.R. (SCHNEIDER 1956).

As yet unpublished material of TSCHIGOVA from the Upper Famennian of the Russian Platform and a questionable occurrence of the genus in the Frasnian of Thuringia (see SOHN 1969, p. C4) indicate that this genus extended from Upper Devonian into the Dinantian.

4. PALYNOLOGY

(M. STREEL)

4.1. BIOSTRATIGRAPHY ON SPORES

When publishing a first biostratigraphic chart of the Famennian stage in the type localities of Belgium (BOUCKAERT, STREEL and THOREZ 1968, "hors-texte" III; BOUCKAERT, STREEL, THOREZ and MOUND 1969, text-fig. 2), it has been stated that the purpose of the spore range chart was twofold: 1) to show the stratigraphic range in well-dated marine sediments of some species originally known from other areas with the hope that a correct age assignment of these species in the type sections would provide a sound basis for interregional correlations; 2) to illustrate the nature of the quantitative data which have allowed precise correlations within the limits of the Dinant basin (B.S.T. 1968, "hors-texte" I and II). Semiquantitative data of some species were provided for this purpose and it was claimed that those species were selected for their apparent lack of facies restriction in a complete *continuous marine succession*.

The aim of the present contribution is to improve the data concerning both points 1 and 2, emphasizing the second one.

4.1.1. STRATIGRAPHIC SPORE RANGE CHART

The Upper Devonian spore range chart (see enclosure II, 1) improves and completes the Upper Famennian spore range chart given by PAPROTH and STREEL (1971, fig. 3). This new chart is also made on a new systematic approach. The aim of this systematic part is, first of all, to provide the reader with a synoptical presentation of all the spore species so far published and figured in the Upper Devonian of Belgium. Most of the data come from the sections figured by BOUCKAERT, STREEL and THOREZ (1968: "hors-texte" I and II). Additional data are provided by boreholes in the Namur basin (Tournai, Wépion) and in the Kempen basin (Booischoot). For the explanations of faunal controls of our data*, we refer to the biostratigraphic chart of the Famennian stage (B.S.T. 1968 and B.S.T.M. 1969) and to the Frasnian chart published in STREEL 1972a.

If one just looks on the spore range chart, it immediately becomes evident that there is a strong dissymmetry between the rate of the first occurrences and the rate of the disappearances of species. Both rates could be the result of some facies control of the lateral distribution of spores.

4.1.2. LATERAL DISTRIBUTION OF SPORES AND ACRITARCHA

From the continental production centers to the most off-shore marine environment, the assemblages of

* In enclosure II, 1, read *Basilicorhynchus* instead of "Pugnoïdes" and *marginifera* instead of quadrantinod.

spores may vary in qualitative and quantitative composition when passing through different filters like changes in the energy level of fluvial and marine currents.

The most continental Upper Devonian beds so far reached in Belgium are conglomerates met in the Booischot borehole, located north of Brussels on the southern margin of the Kempen basin. The green part of the conglomerates (the underlying red part being devoid of any spores) has at first been considered of Middle Devonian age (STREEL 1965) but was recently more accurately dated as Frasnian (STREEL 1972a: fig. 1). An Upper Devonian age had been suggested by STOCKMANS and WILLIÈRE (1964) when describing *Archaeopteris fimbriata* NATHORST from the same material. This part of the borehole is indeed very rich in plant macroremains. Most were noted by R. LEGRAND when describing the lithological log and these data were kindly provided to us (see enclosure II, 2 and also LEGRAND 1962). The qualitative distribution of spores is rather similar throughout the section but the quantitative distribution is uneven. The "hystriospores" (in black on the histograms, enclosure II, 2) are more abundant in those parts of the borehole where the sediments are coarse (see plate 25, figs. 7, 11 and 12). On the contrary, *Aneurospora greggsii* is the most dominant spore where the sediments are fine (see plate 25, fig. 8) containing Kaolinite subordinated to the Illite. Reaching percentages as high as 88% of the total population of spores, *A. greggsii* is believed to represent the local (*Archaeopteris*?) Frasnian vegetation. Linked to the coarser sediments, the "hystriospores" are presumed to originate with fluvial sediments from "uplands".

Obviously there is a direct relationship between the size range of the total population of spores and the grain size of the sediments. The interquartile difference of all spores sizes is much smaller when the sediment is finer, as merely a result of a change in the 3rd quartile value. Probably there is also a relationship between these criteria (interquartile difference, 3rd quartile value) and the energy level of currents which have carried these assemblages.

Now using the same criteria, compare (enclosure II, 3) the interquartile difference of all spore sizes from Frasnian continental beds (Bo.) with those observed in marine beds from about the same age in the South-Eastern part of the Dinant basin (localities Aywaille — Ayw. — and My). The interquartile differences are nearly the same but concern the range 36–55 μ in the marine beds and the range 56–75 μ in the continental beds. This means that one species which has a specific size range falling within one of these interquartile differences, has a good chance to be eliminated from the population corresponding to the other one. Obviously, this is the result of what we will name later on a "sorting effect" during the transport of spores.

If considering now the investigated sections of the

Lower Famennian in Belgium (see enclosure II, 3: sections of Senzeilles, Huy and Villers sur Lesse, each one bearing typical successions of brachiopod faunas), it appears that this "sorting effect" has reached a critical point (interquartile difference: 10 μ) which has allowed a few spore species only to be recorded in the sediments. On the contrary, this sorting process has been less and less effective higher up in the Upper Famennian where the 3rd quartile value is progressively increasing.

Such a method of investigation is helpful for judging of the reliability of the specific size range of a taxon. For instance (enclosure II, 3: each dot represents the maximum diameter size of one specimen of *A. greggsii*) the upper limit of the size range of *A. greggsii* is believed to reflect a biometric feature only in the Upper Famennian samples. Elsewhere, the specific size range of this species is similar to the all spores size range and therefore suspected to have been controlled by a "sorting effect" before sedimentation.

But it is assumed that this method is also a tool for the reconstruction of paleoenvironments as proposed on enclosure II, 4 where a set of triangles summarizes the "sorting effect" of currents in the Upper Devonian through the size characteristics of the all spores populations: these triangles are progressively shaded from white to black when the 3rd quartile value is growing and their base is larger when the interquartile difference increases. In addition to the Booischot and Senzeilles data, 11 triangles summarize the data measured in 40 samples of the Evieux Fm. which is an Upper Famennian unit where the continental influences are the most effective in a general marine environment.

Of more classical use for reconstruction of paleoenvironment are the changes in "ponderal" frequency of spores and also the changes in relative abundance of spores from the land and presumed marine phytoplankton like *Acritarcha*.

In the Senzeilles samples generally less than 5000 spores/gr. of sediment make up only 15 to 40% of the total of the plant microfossils. In the transitional Lower to Upper Famennian beds of Villers sur Lesse and Esneux (Ourthe valley) the ratio spores/all plant microfossils fluctuates between 50 and 75% and, in a borehole covering at Villers sur Lesse the same interval of time, there is a sudden increase of the amount of spores when crossing the boundary Fa1/Fa2, reaching 15–20.000 spores/gr. of sediment. In the Upper Famennian Montfort and Evieux Fm., spores represent 85 to 100% of all plant microfossils and may vary in quantity from 20.000 tot 85.000 spores/gr. of sediment.

All spores size range, spores/all plant microfossils ratio and spores "ponderal" frequency are useful, partially related, criteria for paleoenvironment reconstruction. They well reflect different aspects of the regressive marine conditions more and more prevailing in the areas which can be sampled in Belgium from the

Lower to the Upper Famennian. It is not until the base of the Upper Famennian that the criteria of first occurrence of one species can be used for erecting a zonation since below that level adverse conditions in lateral transport of spores are prevailing. This explains how the partially published (B.S.T. 1968) and here completed zonation has been built (enclosure II, 1). The *A. langi*-*S. triangulatus* (LT) zone is subdivided in a lower and an upper subzone on the occurrence of *S. sp. aff. S. inusitatus* which appears in the same environment (Booischoot borehole) as below. But the *A. greggsii*-*R. planus* zone (GP instead of IP in B.S.T. 1968) could have partially the same age as the LT zone, occurring in a quite different environment. This rather long-ranging zone is for the time being subdivided in three subzones (GP2/GP3/GP4) on the quantitative ratio *A. greggsii* and *R. planus*, a not to good criterium because of the scarcity of material so far studied. The *G. gracilis*-*S. sp. cf. A. hirtus* (GH) zone is much better defined with the first occurrence of two species of *Auroraspora* and continuous occurrence of the guide species but its lower limit is not very precise corresponding to that increase in lateral distribution of spores that we have noted near the Fa1/Fa2 boundary. The following zone (*G. gracilis*-*cf. E. "minutus"* *: GM) is based on the successive first occurrences of *Grandispora* species and also on the now frequent occurrence of *Auroraspora hyalina*. Subdivisions within this zone and lower limit of the following one (*R. versabilis*-*G. uncata*: VU zone) are mainly based on major quantitative fluctuations of long ranging species like *R. planus*, *G. gracilis*, *A. greggsii* and a few other species which are also amongst the lateral most widespread species since occurring in the "sorted facies" of the Lower Famennian.

Using the lateral sedimentological sequence presented in this paper by J. THOREZ, we intend now to test these quantitative major fluctuations in order to prove that these are of biostratigraphical significance.

J. THOREZ has kindly accepted to classify 63 shaly samples in 6 subdivisions of his lateral sequence using only sedimentological criteria (enclosure II, 6: A (A)-B, C-D, (D)-E-(F), G-(H), (H)-I). The mean percentage of the nine species concerned has been tabulated for each subzone and transformed in thicker bands when this mean value is higher. Note that each facies has not been met by each subzone. If we except the alluvial (A) facies, it is obvious that *A. greggsii*, *R. planus*, *G. gracilis* and *Auroraspora cf. P. perinatus* change quantitatively more with the stratigraphic sequence than with the lateral facies sequence. These quantitative changes can be used for correlation purpose within the limits of facies B to I.

These lateral changes in species frequency could be expected to be more important when analysing the

range of variation of different characteristics of the shales and the "palynofacies" which has been extracted from this shales.

Most of the samples used here before can be located on the environmental reconstruction presented by J. THOREZ. They are shown (enclosure II, 5) with some additional data of the upper VU subzone, in the same lithological context as published by BOUCKAERT, STREEL and THOREZ in 1968 ("hors-texte" I). But identification numbers of samples are here replaced by different symbols summarizing the following characteristics: abundance of large organic remains, types of organic or mineral remains in slides (see plate 25), all spores size range ("sorted" and "less sorted" separated by a 3rd quartile at 56 μ), abundance of spores, shale type (pelo- to pelitoshales and micropelites, see plate 25) and colour (brown or grey).

The occurrence of red beds throughout that part of the basin from the subzone GMs is reflected in the colour of shales which are often brown in the VU zone. Less sorted assemblages are typically linked to alluvial (A) facies and sandy flats of the fore barrier (G). The barrier environment lacks spores in its thickest part but has "sorted" assemblages on the margins, with different amount of organic remains, often with "dust remains". Samples from the most marine conditions (I) associate "sorted" assemblages with palynofacies devoid of "dust remains", but rich in mineral remains.

These characteristics reveal different kinds of energy level on both sides of the barrier complex. Their relationship with the minor quantitative differences in the spore assemblages will be tested with the help of a computer and described in an other paper. Here the main conclusion will be that these spore assemblages are rather uniformly distributed through the barrier environment. The change in quantitative behaviour of spores between the alluvial-lagoonal facies and the true alluvial facies suggests that the most widespread species will have been transported by marine rather than by fluvial currents. This suggestion is matched with the observation that only marine shales (with acritarcha) contain abundant spores in all the environments so far studied in the Upper Famennian. This is of course also true in the transgressive highest Famennian sediments (Tn1a) where other sediments than shales are practically devoid of spores. It must be noted for instance that M. J. M. BLESS has so far succeeded to find a pair of spores from one kilogram of an ostracode limestone in the Bocq valley (see plate 23).

Indeed in contrast with the result of SMITH and SAUNDERS (1970) data on Acritarch distribution in a Silurian — but to some extent comparable — barrier system environment, the Acritarcha are not rare in the back barrier lagoonal environment of the Upper Famennian in the Ourthe valley. This is interpreted

* The name *Endosporites gr. minutus* is here maintained to avoid any confusion between *A. hyalina* and *A. hirtus*, both to be abbreviated with a H.

as a further evidence that marine incursions in the back barrier lagoonal system were dominant over the fluvial discharges. As shown by SMITH and SAUNDERS (1970) alluvial sediments are practically devoid of Acritarcha (see enclosure II, 5: Ev section). This poor assemblage (a) is characterized by a few specimens of leiospherids, lophospherids and *Gorgonisphaeridium* sp. In the Upper Famennian back barrier tidal lagoon (see enclosure II, 5: Go) a rather diversified assemblage of Acritarcha is present, characterized by frequent to abundant (maximum 10% of all plant microfossils) *Michrhystridium*, *Gorgonisphaeridium* sp. and leiosphaerids (assemblage b). This assemblage is impoverishing in the upper part of the La Gomme section where the amount of spore tetrads is increasing, a feature that we interpret as an alluvial influence. A nearly similar assemblage is present in the upper part of the Beverire section, but *Michrhystridium* is lacking, replaced by Lophospherids and the first occurrence of *Gorgonisphaeridium winslowii* (assemblage b'). In the fore barrier tidal flats, the acritarcha assemblage is also rather diversified but characterized by *Lophosphera* sp. (assemblage c). Another assemblage is present within the PL zone in the transgressing facies at the top of the Famennian and characterized by the abundance (up to 15%) of *Gorgonisphaeridium winslowii*.

4.2. SYSTEMATICS

The photographs of plates 15-25 have been made with a ZEISS photomicroscope, several of them with phase-contrast. Part of the photographs have been made with the CAMBRIDGE STEREOSCAN.

All slides have been deposited with the palynological collections of the Paleobotany and Paleopalynology Department of the University of Liège, except for the specimens of figures 11 to 17 on plate 23, which have been stored with the palynological collections of the Geologisch Bureau of the Netherlands Geological Survey at Heerlen. In the explanation of the plates, the number of each slide is followed by a reference grid number.

LAEVIGATI (BENNIE & KIDSTON) POTONIÉ 1956

Genus *CALAMOSPORA* SCHOPF, WILSON & BENTALL 1944.

- *Calamospora microrugosa* (IBRAHIM) S., W. & B. 1944 (pl. 15, figs. 1, 2).

Genus *LEIOTRILETES* (NAUMOVA) POTONIÉ & KEMP 1954.

- *Leiotriletes pyramidalis* (LUBER) ALLEN 1965 (pl. 15, fig. 3).
- *Leiotriletes inermis* (WALTZ) ISCHENKO 1952 (pl. 15, fig. 7).
- *Leiotriletes* (al. *Hymenozonotriletes*) *velatus* (CARO-MONIEZ) comb. nov. (pl. 15, figs. 4-6).
Hymenozonotriletes velatus CARO-MONIEZ 1962: XVII, 8; non *H. velatus* NAUMOVA 1953; *Perotriletes* sp. in STREEL 1965, I: 2; very thin, transparent, external layer of exine irregularly separated from "body".

Genus *PUNCTATISPORITES* (IBRAHIM) POTONIÉ & KREMP 1954.

- *Punctatisporites glaber* (NAUMOVA) PLAYFORD 1962 (pl. 15, fig. 8).

RETUSOTRILETI infraturma nov.

"Retusoid" azonate, not patinate, trilete spores. "Retusoid" spores have structural features delineating the contact areas and/or characterizing these areas.

Genus *RETUSOTRILETES* (NAUMOVA) STREEL 1964.

- *Retusotriletes planus* DOLBY & NEVES 1969 (pl. 15, figs. 9, 10).
Phyllotheccotriletes cf. *nigritellus* LUBER 1955 in STREEL 1965, I: 1; cf. *Punctatisporites irrasus* HACQUEBARD 1957 in STREEL 1966, II: 26; *Punctatisporites irrasus* HACQUEBARD 1957 in B.S.T. 1968, B.S.T.M. 1969.
- *Retusotriletes* sp. A (pl. 15, figs. 11, 12).
Thin triangular apical area; radial folding and/or thickening of the contact area. 48-69 μ (9 specimens).

Genus *APICULIRETUSISPORA* (STREEL) STREEL 1967.

- *Apiculiretusispora* (al. *Retusotriletes*) *verrucosa* (CARO-MONIEZ) comb. nov.
Retusotriletes verrucosus CARO-MONIEZ 1962, XVI: 1, 2; non *R. verrucosus* (NAUMOVA in litt.) KEDO 1955;
Baculatisporites fusticulus SULLIVAN 1968.
- *Apiculiretusispora plicata* (ALLEN) STREEL 1967 (pl. 15, figs. 13-16).
- *Apiculiretusispora* sp. cf. *Ac. inferus* NAUMOVA 1953 (pl. 15, figs. 17-20).
Acanthotriletes inferus NAUMOVA 1953: 1, figs. 13, 14.
Densely covered with small spinae (1 μ high; 0.5 μ wide).

Genus *PULVINISPORA* BALME & HASSELL 1962.

- *Pulvinispora depressa* BALME & HASSELL 1962 (pl. 16, fig. 1).
- *Pulvinispora* sp. A (pl. 16, figs. 2, 3); exine 1 μ thick. Small radial crassitude (1-3 μ wide); 25-33 μ (4 specimens).

Genus *ANEUROSPORA* STREEL 1964.

- *Aneurospora* (al. *Retusotriletes*) *incohata* (SULLIVAN) comb. nov. (pl. 16, fig. 4).
Retusotriletes incohatus SULLIVAN 1964 (pl. 1, figs. 5-7); *R. incohatus* SULLIVAN in STREEL 1966, II: 22, 23; *R. incohatus* SULLIVAN in PAPROTH & STREEL 1971, 26: 5.
See "remark" under *A. semizonalis* in LELE & STREEL 1969, p. 96. The external layer of exine can be microfolded.
- *Aneurospora semizonalis* (MC GREGOR) LELE & STREEL 1969 (pl. 16, fig. 5).
- *Aneurospora* (al. *Retusotriletes*) *greggsii* (MC GREGOR) comb. nov. (pl. 16, figs. 6-15).
Retusotriletes greggsii MC GREGOR 1964; *Aneurospora* sp. in STREEL 1965, I: 16-18; cf. *Crassisporea balteata* (PLAYF.) SULLIVAN in STREEL 1966, II: 24, 25; *Retusotriletes punctatus* CHIBRIKOVA in B.S.T. 1968, 1971; in B.S.T.M. 1969, 93: 1-4 in PAPROTH & STREEL 1971, fig. 3.
See "comparisons" under *A. goensis* in LELE & STREEL 1969, p. 95 and fig. 2.
The ornamentation of *R. punctatus* CHIBRIKOVA cannot be proved similar with *R. greggsii* — see MC GREGOR 1964, p. 10.
A large "species" concept is here adopted accepting progressive changes in size from the top of the Givetian (37-112 μ) to the top of the Famennian (22-52 μ).
Abrupt change in size from Frasnian continental sedi-

ments (enclosure II, 3: Bo. 918-928) to Frasnian marine sediments (enclosure II, 3: Ayw. 1, My 1) is believed to reflect a sorting effect during sedimentary processes.

APICULATI (BENNIE & KIDSTON)

POTONIÉ 1956

Genus *GEMINOSPORA* BALME 1962.

- *Geminospora svalbardiae* (VIGRAN) ALLEN 1965 (pl. 16, figs. 16-19).

Genus *VERRUCOSISPORITES* (IBRAHIM) SMITH 1964.

- *Verrucosisporites grandis* MC GREGOR 1960 (pl. 17, figs. 13, 14);
Verrucosisporites nitidus PLAYFORD in PAPROTH & STREEL 1971, 25: 7.

Genus *ACANTHOTRILETES* (NAUMOVA) POTONIÉ & KREMP.

- *Acanthotriletes hacquebardii* PLAYFORD 1964 (pl. 17, figs. 8, 9).
— *Acanthotriletes jamenensis* NAUMOVA 1953;
A. jamenensis NAUM. in COMBAZ & STREEL 1971, 3: 4.

Genus *ANAPICULATISPORITES* POTONIÉ & KREMP.

- cf. *Anapiculatisporites hystricosus* PLAYFORD 1964 (pl. 17, fig. 7).
— *Anapiculatisporites* sp. A (pl. 17, figs. 10-12).
Proximal exine (less than 1 μ thick) unornamented with 3 interrational papillae. Distal exine thicker (1 μ) bearing small coni ($\frac{1}{2}$ μ high); 28-36 μ (12 specimens).

Genus *DIBOLISPORITES* RICHARDSON 1965.

- *Dibolisporites echinaceus* (EISENACK) RICHARDSON (pl. 17, figs. 1, 2); species concept in agreement with MC GREGOR 1973, p. 29.
— *Dibolisporites* sp. cf. *Lophotriletes atratus* NAUMOVA 1953 (pl. 17, figs. 3-6).
Lophotriletes atratus NAUMOVA 1953, Tab. XVIII, fig. 17.

Genus *PUSTULATISPORITES* POTONIÉ & KREMP.

- *Pustulatisporites gibberosus* (HACQUEBARD) PLAYFORD 1964.
P. gibberosus PLAYFORD in PAPROTH & STREEL 1971, 26: 3.

Genus *RAISTRICKIA* (SCHOPF, WILSON & BENTALL) POTONIÉ & KREMP 1954.

- *Raistrickia ampullacea* HACQUEBARD 1957 (pl. 17, figs. 20, 21).
Raistrickia sp. A. SULLIVAN in STREEL 1966, II: 18, 19.
Baculae (2-7 μ high) with rounded top and constriction of diameter 1 μ below the top.
— *Raistrickia variabilis* DOLBY & NEVES 1970 (pl. 17, fig. 19; pl. 23, figs. 15, 16).
Hystrichosphaeridium trifurcatum EIS. in CARO-MONIEZ 1962, XVII: 11, 12;
Raistrickia sp. in B.S.T.M. 1969, 94: 6.
— *Raistrickia macrurus* (LUBER) DOLBY & NEVES 1970.
R. macrurus DOLBY & NEVES in COMBAZ & STREEL 1971, 4: 10, 11.

CINGULATI POT. & KLAUS 1954

Genus *LOPHOZONOTRILETES* (NAUM.) POTONIÉ 1956.

- *Lophozonotriletes lebedianensis* NAUMOVA 1953 (pl. 17, figs. 15-17).

External layer of exine often destroyed in our samples; see detail of ornament fig. 17: completely destroyed on left, partially destroyed on right.

- *Lophozonotriletes* cf. *curvatus* NAUMOVA 1953 (pl. 17, fig. 18).
— *Lophozonotriletes rarituberculatus* (LUBER) KEDO 1957.
L. rarituberculatus KEDO in STREEL 1966, II: 16, 17;
in PAPROTH & STREEL 1971, 25: 4.

Genus *KNOXISPORITES* (POT. & KR.) NEVES 1961.

- *Knoxisporites* cf. *pristinus* SULLIVAN 1968 (pl. 17, fig. 22).

Genus *VALLATISPORITES* HACQUEBARD 1957.

- *Vallatisporites pusillites* (KEDO) DOLBY & NEVES 1969.
cf. *Hymenozonotriletes pusillites* KEDO in STREEL 1966, II: 20, 21;
H. pusillites KEDO in B.S.T.M. 1969, 94: 7;
Vallatisporites pusillites (KEDO) DOLBY & NEVES in PAPROTH & STREEL 1971, 25: 1.

Genus *CRISTATISPORITES* POTONIÉ & KREMP 1954.

- *Cristatisporites echinatus* PLAYFORD 1963 (pl. 18, fig. 1).

PATINATI BUTTERWORTH & WILLIAMS 1958

Genus *CYMBOSPORITES* ALLEN 1965.

- *Cymbosporites* cf. *cyathus* ALLEN 1965 (pl. 18, figs. 2, 3).

ZONATI POTONIÉ & KREMP 1954

Genus *SAMARISPORITES* RICHARDSON 1965.

- *Samarisporites triangulatus* ALLEN 1965 (pl. 18, figs. 4-7).
— *Samarisporites* sp. aff. *S. inusitatus* ALLEN 1965.
Calypsoisporites microspinosus RICH. in STREEL 1965, II: 10.
— *Samarisporites* sp. cf. *Hymenozonotriletes acanthyrugosus* CHIBRIKOVA 1959 (pl. 18, fig. 8).
See also STREEL 1965, I: 4, 5.
— *Samarisporites* sp. cf. *Acanthotriletes hirtus* NAUMOVA 1953 (pl. 18, figs. 9-12).
cf. *Acanthotriletes hirtus* NAUM. in B.S.T. 1968,
in B.S.T.M. 1969, in PAPROTH & STREEL 1971.

MONOPSEUDOSACCITI

SMITH & BUTTERWORTH 1967

Genus *GRANDISPORE* HOFF., ST. & MALLOY emend NEVES & OWENS (sensu PLAYFORD 1971).

Largely accepting PLAYFORD (1971) restatement and MC GREGOR (1973) emendation of *Grandispora*, we prefer so far to keep *Samarisporites* outside the new generic concept of *Grandispora*. We have condensed in fig. 12 some criteria on shape, size and number of ornaments for different species of *Grandispora*.

- *Grandispora* (al. *Hymenozonotriletes*) *microseta* (KEDO) comb. nov. (pl. 18, figs. 13-17).
Hymenozonotriletes microsetus KEDO, tab. V, fig. 129;
H. microsetus KEDO in B.S.T. 1968, 1971; PAPROTH & STREEL 1971; B.S.T.M. 1969, 93: 9, 10.

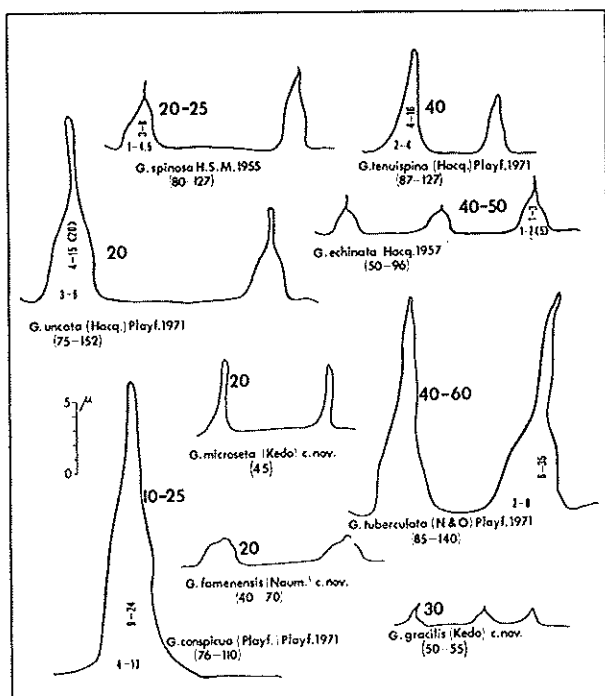


FIG. 12 — Sculptural elements on a few species of *Grandispora*. Below the species name: range of spore diameter size in μ . Inside the ornaments, horizontally: range of basal diameter size in μ ; vertically: range of ornament length in μ . Outside the ornaments: number of ornaments projecting from margin

- *Grandispora* (al. *Archaeozonotrilletes*) *gracilis* (KEDO) comb. nov. (pl. 19, figs. 1-3).
Anapiculatisporites in STREEL 1968, I: 16;
Archaeozonotrilletes gracilis KEDO in B.S.T.M. 1969, 93: 11, 12.
- *Grandispora conspicua* (PLAYF.) PLAYFORD 1971 (pl. 19, figs. 7, 8).
Spinozonotrilletes conspicuus PLAYFORD in PAPROTH & STREEL 1971.
- *Grandispora* (al. *Archaeozonotrilletes*) *famenensis* (NAUMOVA) comb. nov. (pl. 19, figs. 9, 11).
Archaeozonotrilletes famenensis NAUMOVA in B.S.T. 1968, 1971, in B.S.T.M. 1969, in PAPROTH & STREEL 1971.
- *Grandispora* cf. *tenuispina* (HACQ.) PLAYFORD 1971.
Dibolisporites in STREEL 1968, I: 10;
Acinosporites in STREEL 1968, I: 13;
Spinozonotrilletes cf. *S. tenuispinus* HACQ. in B.S.T.M. 1969, 93: 6;
Spinozonotrilletes cf. *tenuispinus* HACQ. in B.S.T. 1968, 1971, in PAPROTH & STREEL 1971.
- *Grandispora* cf. *tenuispina* (HACQ.) PLAYFORD 1971 var. *punctata* var. nov. (pl. 19, figs. 12, 13).
Exine densely pitted (corrosion pattern?) and thicker than var. *typica*.
- *Grandispora uncata* (HACQ.) PLAYFORD 1971.
Acanthotrilletes acutus CARO-MONIEZ 1962, XVI: 11;
Spinozonotrilletes cf. *uncatus* in STREEL 1966, II: 27, in STREEL 1968, I: 7, in B.S.T.M. 1969, 93: 7, 8;
46-69 μ (38 specimens) against 74-152 μ for specimens of Middle and Upper Tournaisian age.
- *Grandispora* sp. A (pl. 19, figs. 4-6).
Exoexine (1 μ thick) bearing coni and verrucae (1 μ high and wide), sparsely distributed on distal surface.
38-46 μ (4 specimens).

Genus *SPELAEOTRILETES* NEVES & OWENS 1966.

- *Spelaeotrilletes* (al. *Hymenozonotrilletes*) *cassis* (KEDO) comb. nov. (pl. 20, fig. 1).
Hymenozonotrilletes cassis KEDO 1957, tab. II, fig. 18;
Spelaeotrilletes arenaceus NEVES & OWENS 1966;
H. cassis KEDO in KEDO & GOLUBCOV 1971, tab. IV, fig. 12 ex STREEL 1966, I: 12.
- *Spelaeotrilletes* (al. *Hymenozonotrilletes*) *lepidophytus* (KEDO) comb. nov. (pl. 20, figs. 2-4; pl. 23, figs. 11-13).
Hymenozonotrilletes lepidophytus KEDO 1957, tab. II, figs. 19-21;
H. lepidophytus KEDO in STREEL 1966, I: 1-11, in STREEL 1968, I: 4, 5, in OWENS & STREEL 1967, I: A-G, in PAPROTH & STREEL 1971, 25: 5.
The specimen figured plate 20: 4 shows a typical ornamentation of the small forms (var. *minor* KEDO) occurring in the upper part of the biozone.
- *Spelaeotrilletes* sp. A (pl. 20, figs. 5-7).
Hymenozonotrilletes aff. *H. archaeolepidophytus* KEDO 1955 in PAPROTH and STREEL 1971, 25: 2, 3;
H. lepidophytus KEDO var. *macroreticulatus* KEDO in KEDO & GOLUBCOV 1971, tab. II, figs. 1-3.
Compare density of micro-ornaments of this species (fig. 6) with more sparse ornament of *S. lepidophytus*. See also the fragility of the external layer of exine, distally destroyed on specimen fig. 7.

Genus *RHABDOSPORITES* RICH. 1960.

- ? *Rhabdosporites* cf. *parvulus* RICH. 1965 (pl. 20, figs. 15, 16).
- *R. langi* RICH. in STREEL 1965, II: 8.
Conate (eroded?) sculpture.

Genus *AURORASPORA* (HOFF., ST. & MALLOY) RICHARDSON 1960.

- *Auroraspora* (al. *Hymenozonotrilletes*) *poljessica* (KEDO) comb. nov. (pl. 20, figs. 8-14).
Pl. I, fig. 3 in STREEL 1965.
- *Auroraspora* (al. *Hymenozonotrilletes*) *hyalina* (NAUM.) comb. nov.
Hymenozonotrilletes hyalinus NAUMOVA 1953, tab. XVII, figs. 14, 15.
Pl. I, figs. 7, 8 in STREEL 1965.
Endosporites gr. *minutus* HOFF., ST. & MALLOY in STREEL 1966, II: 28, *pro parte* (9) in B.S.T. 1968, 1971, in B.S.T.M. 1969, 94: 4, in PAPROTH & STREEL 1971.
- *Auroraspora macra* SULLIVAN 1968.
Endosporites gr. *minutus* HOFF., ST. & MALLOY, *pro parte* (10) in B.S.T. 1968, in B.S.T.M. 1969, 94: 5, in PAPROTH & STREEL 1971.
- *Auroraspora solisorta* HOFF., ST. & MALLOY 1955 (pl. 21, fig. 1).
Pl. I, fig. 13 in STREEL 1965.
cf. *Auroraspora solisortus* HOFF., ST. & MALLOY in B.S.T. 1968, 1971, in B.S.T.M. 1969, 94: 1, in PAPROTH & STREEL 1971.
- *Auroraspora* sp. cf. *Perotrilletes perinatus* HUGHES & PLAYFORD 1961 (pl. 21, figs. 6, 7).
Perotrilletes perinatus HUGHES & PLAYFORD 1961, pl. 2, figs. 7-10;
Perotrilletes cf. *perinatus* HUGHES & PLAYFORD in B.S.T. 1968, 1971, in B.S.T.M. 1969, 94: 2, in PAPROTH & STREEL 1971.
The thin, folded external part of the exine does not necessarily exclude this species from the genus *Auroraspora*.
- *Auroraspora* sp. cf. *Diaphanospora perplexa* BALME & HASSELL 1962 (pl. 21, figs. 12-14).
Diaphanospora perplexa BALME & HASSELL 1962, pl. 4, figs. 5-7;

cf. *D. perplexa* BALME & HASSELL in PAPROTH & STREEL 1971.

Same remark as below *A. sp.* cf. *P. perinatus*.

Genus *RUGOSPORA* NEVES & OWENS 1966.

- ☉ *Rugospora* (al. *Hymenozonotrilletes*) *versabilis* (KEDO) comb. nov. (pl. 21, figs. 3-5).
Hymenozonotrilletes versabilis KEDO 1957, tab. III, fig. 4;
H. versabilis KEDO in B.S.T. 1968, 1971, in B.S.T.M. 1969, 94: 3, in PAPROTH & STREEL 1971.
Radial disto-equatorial folding of the external part of exine more (fig. 5) or less (fig. 4) developed.
- ☉ *Rugospora* (al. *Trachytrilletes*) *flexuosa* (JUSCH.) comb. nov. (pl. 21, figs. 8-11).
Trachytrilletes flexuosus JUSCH.;
Trachytrilletes flexuosus JUSCH. in KEDO & GOLUBCOV 1971, tab. V, fig. 1;
ex New York State material from RICHARDSON (see also RICHARDSON in TSCHUDY & SCOTT 1969);
Hymenozonotrilletes famenensis KEDO 1967 in PAPROTH & STREEL 1971.

INCERTAE SEDIS

Presence of an intexine in some species of *Hystricosporites* (see MORTIMER & CHALONER 1967) as well as the variability of zona in *Ancyrospora* do not allow infraturma assignment.

Genus *HYSTRICOSPORITES* Mc GREGOR 1960.

- ☉ *Hystricosporites* cf. *obscurus* MORTIMER & CHALONER 1967.
Hystricosporites corystus RICH. in STREEL 1965, I: 11.
- Hystricosporites multifurcatus* (WINSLOW) MORTIMER & CHALONER 1967 (pl. 22, figs. 1, 2).
- Hystricosporites* sp. aff. *H. multifurcatus* (WINSLOW) MORTIMER & CHALONER 1967.
cf. *Dicrospora multifurcata* WINSLOW in STREEL 1966, II: 13-15;
Dicrospora cf. *multifurcata* WINSLOW in STREEL 1968, I: 8, 9.
Differs from *H. multifurcatus* by basally thicker and more numerous multifurcated appendages.
- *Hystricosporites* sp. A (pl. 22, figs. 3-5).
Long (30-60 μ) bifurcated appendages with rounded, verrucate like basis, well developed on the distal surface. 98-200 μ (5 specimens).

Genus *ANCYROSPORA* (RICH.) RICH. 1962.

- *Ancyrospora ancyrea* (EISENACK) RICH. var. *brevispinosa* RICH. 1962.
Ancyrospora ancyrea var. *ancyrea* RICH. in STREEL 1964, II: 1;
A. ancyrea var. *brevispinosa* RICH. in STREEL 1965, II: 1.
- *Ancyrospora langii* (TAUGOURDEAU-LANTZ) ALLEN 1965 (pl. 22, figs. 11-16).
Ancyrospora longispinosa RICH. in STREEL 1965, II: 2;
A. ancyrea var. *ancyrea* RICH. in STREEL 1965, II: 3.
- *Ancyrospora* sp. A (pl. 22, figs. 6-10).
Ancyrospora grandispinosa RICH. in STREEL 1965, II: 9.
Folded exoexine with dense very small coni bearing short seta.
Bifurcated appendages with two long (6-8 μ) tapering spines.
74-120 μ (8 specimens).
A large "species" concept is here adopted covering specimens (both in *A. langii* and in *A. sp. A*) with external layer of exine irregularly expanding along the bifurcated appendages, sometimes reaching the top of these appendages. See also *A. ancyrea* RICH. var. *spinobaculata* RICH. 1962, pl. 27, fig. 1.

5. PALEOFACIES

(M. J. M. BLESS, M. STREEL, J. THOREZ)

Within the past decade, the study of Paleozoic fossil communities (both marine and non-marine) and their dependence on the sedimentary environment has gained an increased interest of geologists throughout the world. Limiting ourselves to the Devonian and Carboniferous, we may refer to the many papers on this subject in the Calgary-Symposium on the Devonian System (1967) and the last two congresses on Carboniferous Geology and Stratigraphy at Sheffield (1967) and Krefeld (1971).

The fortunate circumstance that the Upper Famennian rocks in the Ourthe valley have received attention from many specialists on brachiopods, foraminifers, algae, conodonts, spores, ostracodes and sediments during this time offers us now a thorough stratigraphic framework on which we may base some paleoecological conclusions.

A concise description of the stratigraphy and sedimentary facies of the Upper Famennian in Belgium has been presented by BOUCKAERT, STREEL & THOREZ in 1968, and has been further elaborated (1970) by the same authors. One of the most relevant things they described, was the strong diachronism of facies in the Ourthe valley. The main goal of this chapter is to check to what extent this diachronism may have influenced the vertical and lateral distribution of some microfossil groups as ostracodes, spores and acritarchs. The conclusions on the environmental dependence of the ostracodes in the Upper Famennian of the Ourthe valley are then also applied to the Lower and Middle Tournaisian of the Dinant and Namur Basins, where a less well studied sedimentary facies has reigned.

5.1. SEDIMENTOLOGICAL AND PALEO-ENVIRONMENTAL REVIEW OF THE "PSAMMITES DU CONDROZ"

(J. THOREZ)

This chapter deals with the sedimentological and paleoenvironmental aspects of the "psammmites du Condroz", especially in their loci typici of the Ourthe valley at the Eastern border of the Dinant synclinalorium. The information used forms part of a more comprehensive but inedited paper (THOREZ 1969). Data on palynology and conodont zonation have been published in part by BOUCKAERT, STREEL & THOREZ (1968).

Since the distribution of spores, acritarchs and ostracodes is largely controlled by the sedimentary facies, it appears useful to present here a synthesis of the principal characteristics of the sediments, from where these microfossils have been extracted.

5.1.1. LITHOLOGY

Petrographical analysis of over 3000 thin sections of the "Psammites du Condroz" has shown, that these are a mixture of many more lithologies than previously known (THOREZ 1969). Although the bulk of the sediments is arenaceous, there exist also several other petrographical types of rocks.

The arenaceous sediments belong to the group of microarkose and psammarkose of MICHOT's 1958 classification. Their mean grain size rarely exceeds 120 μ . They are generally well sorted. The here adopted symbol for these rocks is "Q". Apart from quartz and feldspars (oligoclase, orthoclase, mesoperthite), a high percentage of muscovite-biotite or muscovite-chlorite flakes may be concentrated in some of the laminae of the sediment. Some sedimentary structures may become more conspicuous by these micaceous laminations.

Pelitic material occurs in individual layers alternating with other sediments or as cement in detrital sediment. According to MICHOT's 1958 classification, we distinguish peloshale, pelitoshale, micro- and psammoshale (Pé), micropsammite and psammite (adopted symbol for individual bed: "Pm"; symbol for pelitic contamination:: "pm").

Two different endogenous carbonates occur in the basin, namely dolomites (D) and limestones (C), which may occur together with detrital material ("Pm(C)"; "Q(C)"; "Q(D)"; "Pm(D)").

Field study and petrological analysis have shown that the dolomites are the product of direct precipitation on the substratum of a lagoonal facies protected from the open sea by a barrier complex. The dolomit substance has been formed before the final deposition and subsequent burrowing has taken place. This is proven by the mineral contents of many "mud balls", which are enclosed in arenaceous sediments. The deposition of dolomite may have been postponed when tidal currents seeped into the lagoonal system and displaced the suspended mud. This has resulted in a mixture of dolomite with clay or mica flakes (cf. micaceous laminated dolomites; symbol: Ds).

In arenaceous sediments the dolomite may occur as cement or matrix. In that case it occurs as poecilitic hyaline intergranular dolomite crystallized in voids, or as more or less dusty, cryptograined dolomite, which has been filtered through the skeleton of detrital grains.

The majority of limestones are fossiliferous (crinoids, brachiopods, *Umbellinae*, *Girvanellae* (algae), ostracodes, conodonts). But some do not contain any fossils (cryptite or micrite, the latter in the concept of FOLK). Partial recrystallisation of the matrix may occur (dis-micrite, microsparite). But many of the original features have been left intact. The classification of limestones has been adopted from PIRLET (1965): cryptite,

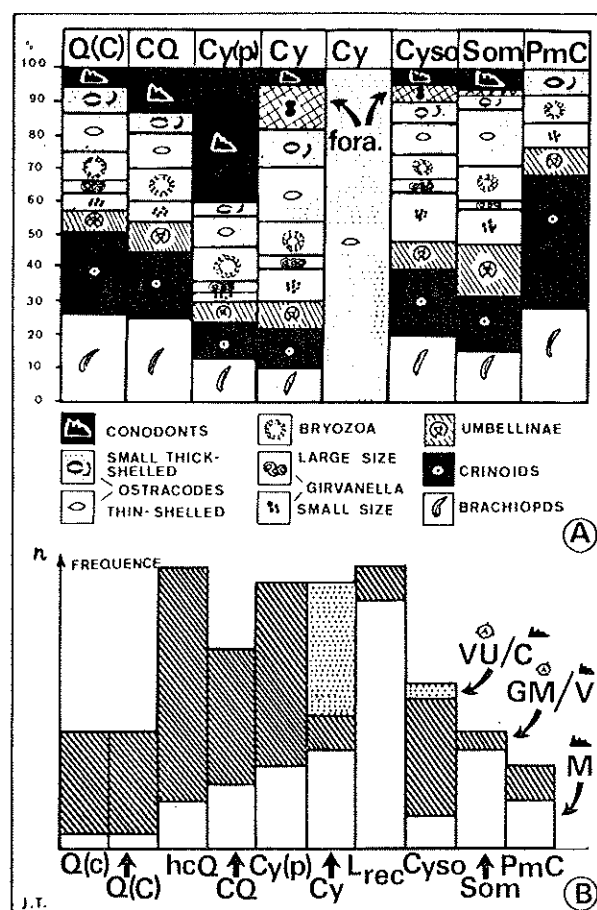


FIG. 13 — A: Relative frequency of micro- and macrofossils in some common calcareous sediments of the Upper Famennian (biozones *Versabilis Uncatus*, *Costatus*; *Gracilis Minutus*, *Velifera*; *Marginifera*). Q(C): calcareous sandstone (psammarkose); CQ: calcarkose or very calcareous (matrix) psammarkose; Cy(Pm): silt-size arenaceous cryptitic (micritic) limestone; Cy: cryptite; Cysom: cryptosomatic limestone; Som: somatic limestone (organoclastic limestone); PmC: calcareous psammite or psammoshale; Lrec: recrystallized limestone.

B: relative frequency of varieties of calcareous sediments in the "Psammites du Condroz" related to the biostratigraphic zonation

crypto-organoclastite, organoclastite (somatite). The limestones may have been contaminated to some degree with detrital material, mud or skeleton grains. The fossil content depends on the petrographical type of limestone (fig. 13 A). Statistical analysis of 325 thin sections has shown that some limestone types are more frequent in a given biozone than in another (fig. 13 B).

Plates 26–30 show examples of some of the common sediments in the Upper Famennian, most of them from the "Psammites du Condroz" of the Ourthe valley. For the sake of simplification, no detailed differentiation between the petrographical varieties has been made in the graphical representation. General descriptive terms as sand, clay, dolomite and limestone are used.

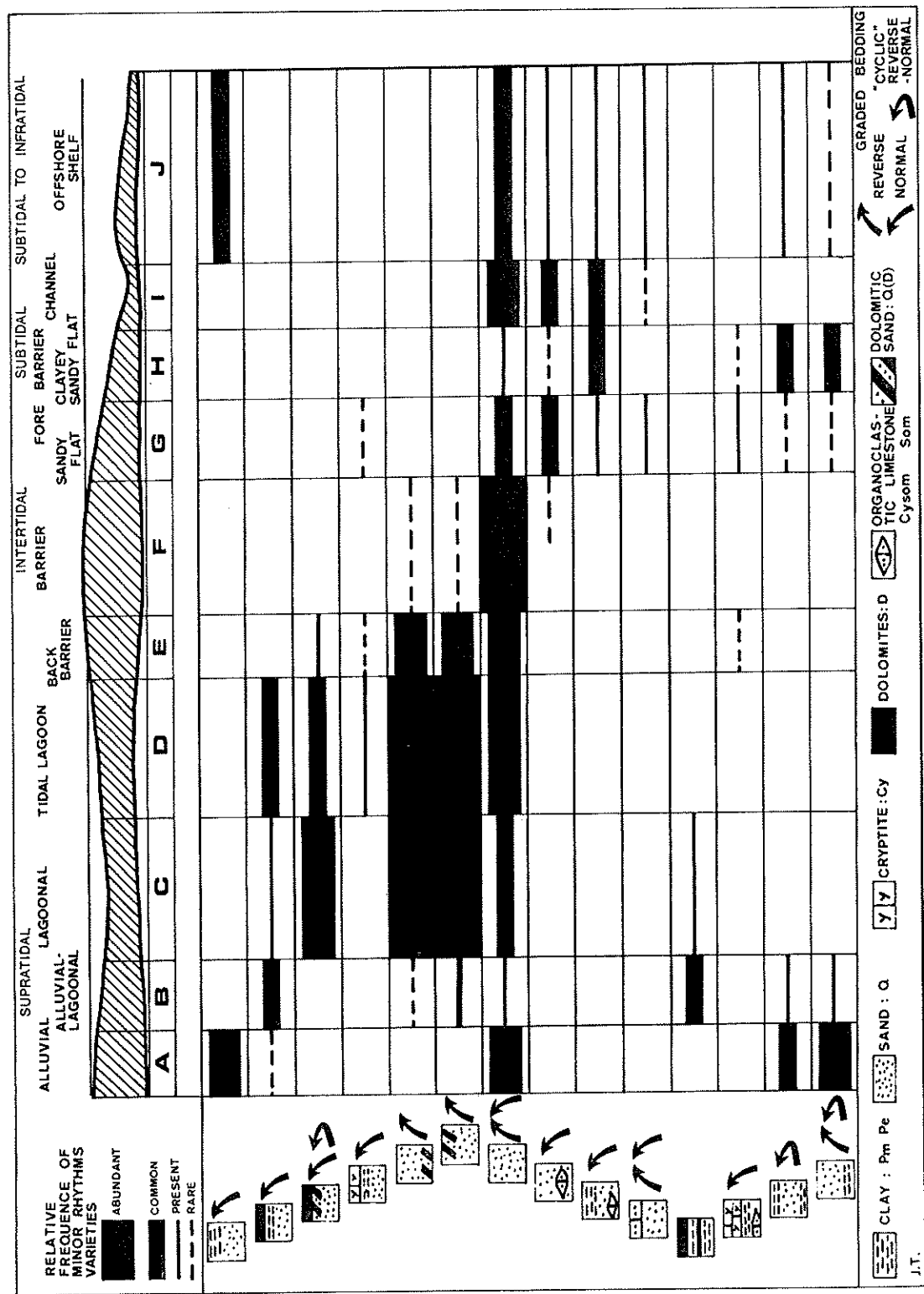


FIG. 14 — Relative abundance of varieties of minor rhythms with their schematized internal, lithological and graded bedding evolution in relationship with their position in the ideal lateral sequence and corresponding sedimentary facies

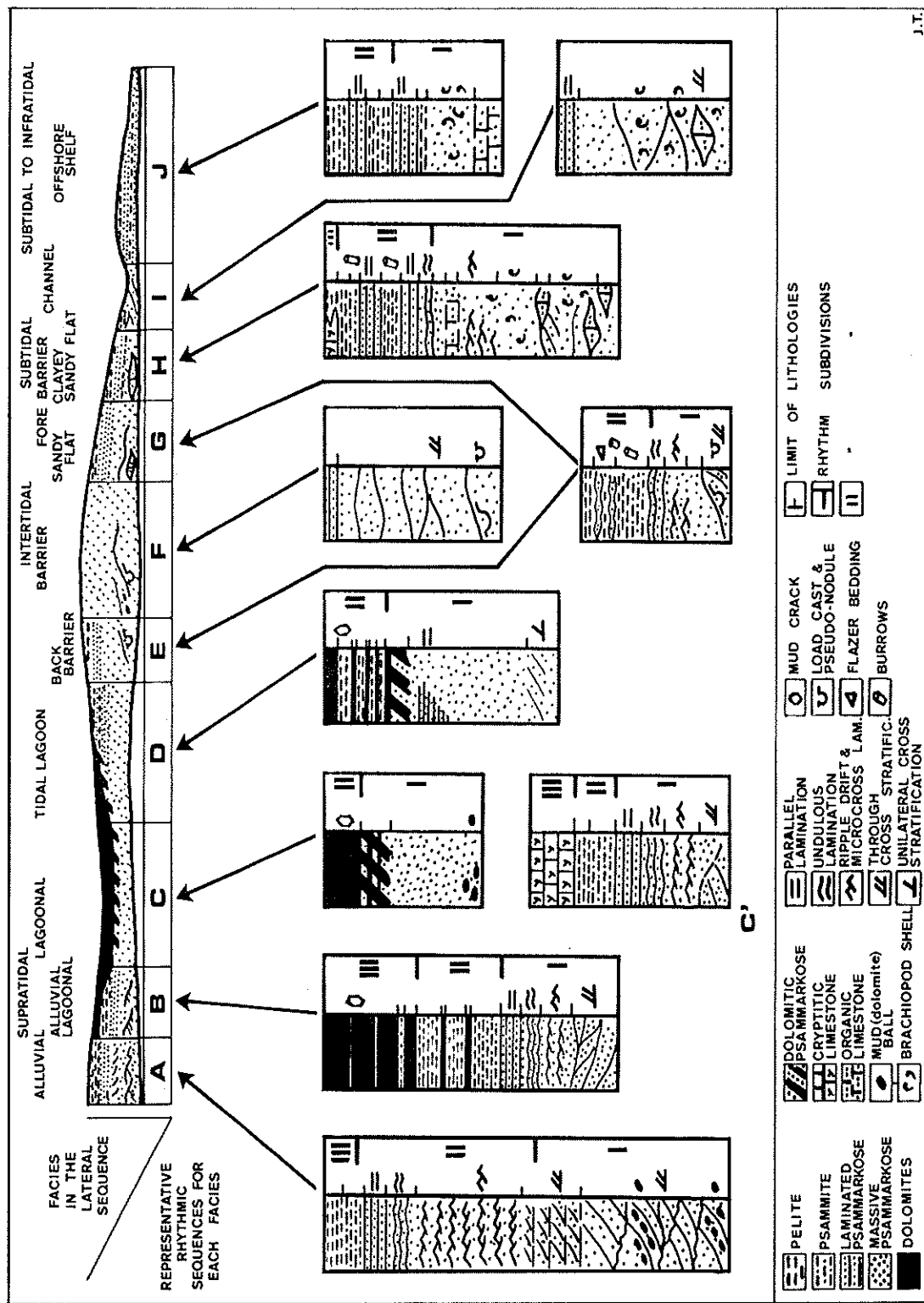


FIG. 15 — Schematic cross section showing position of minor rhythms (lithology and sedimentary structure) in the ideal lateral sequence and corresponding sedimentary facies. Roman numerals (I, II, III) refer to the main internal subdivisions of these rhythms. As shown by a detailed investigation of one thousand rhythmic units, several minor rhythms have been preserved with their different sections I-II or I-II-III. But because of non-deposition or erosion, some of these subdivisions have not been observed in the sections. In some cases, it is possible to reconstruct the ideal rhythmic sequence of a section in a quarry or natural outcrop from the superposition of minor rhythms

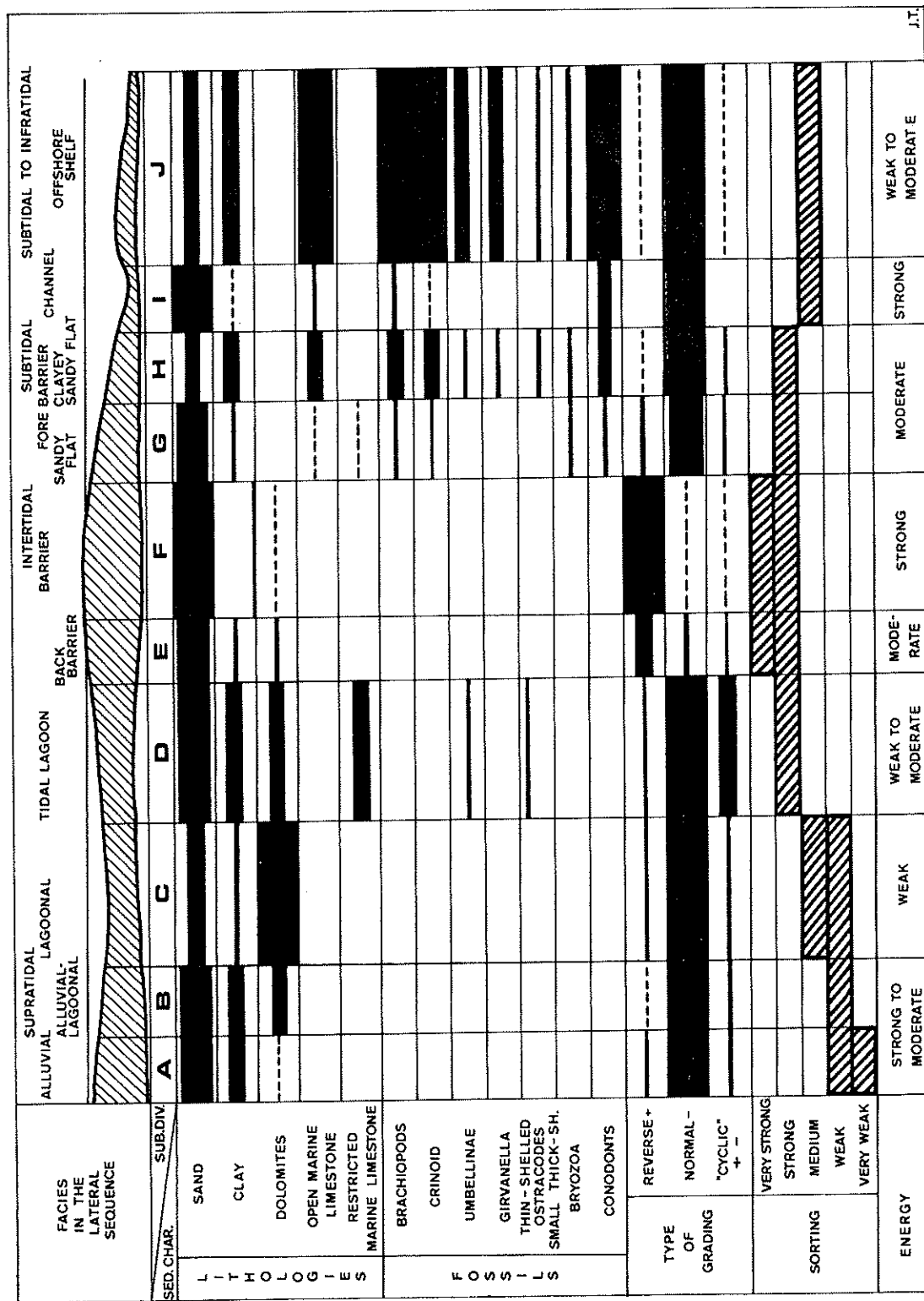
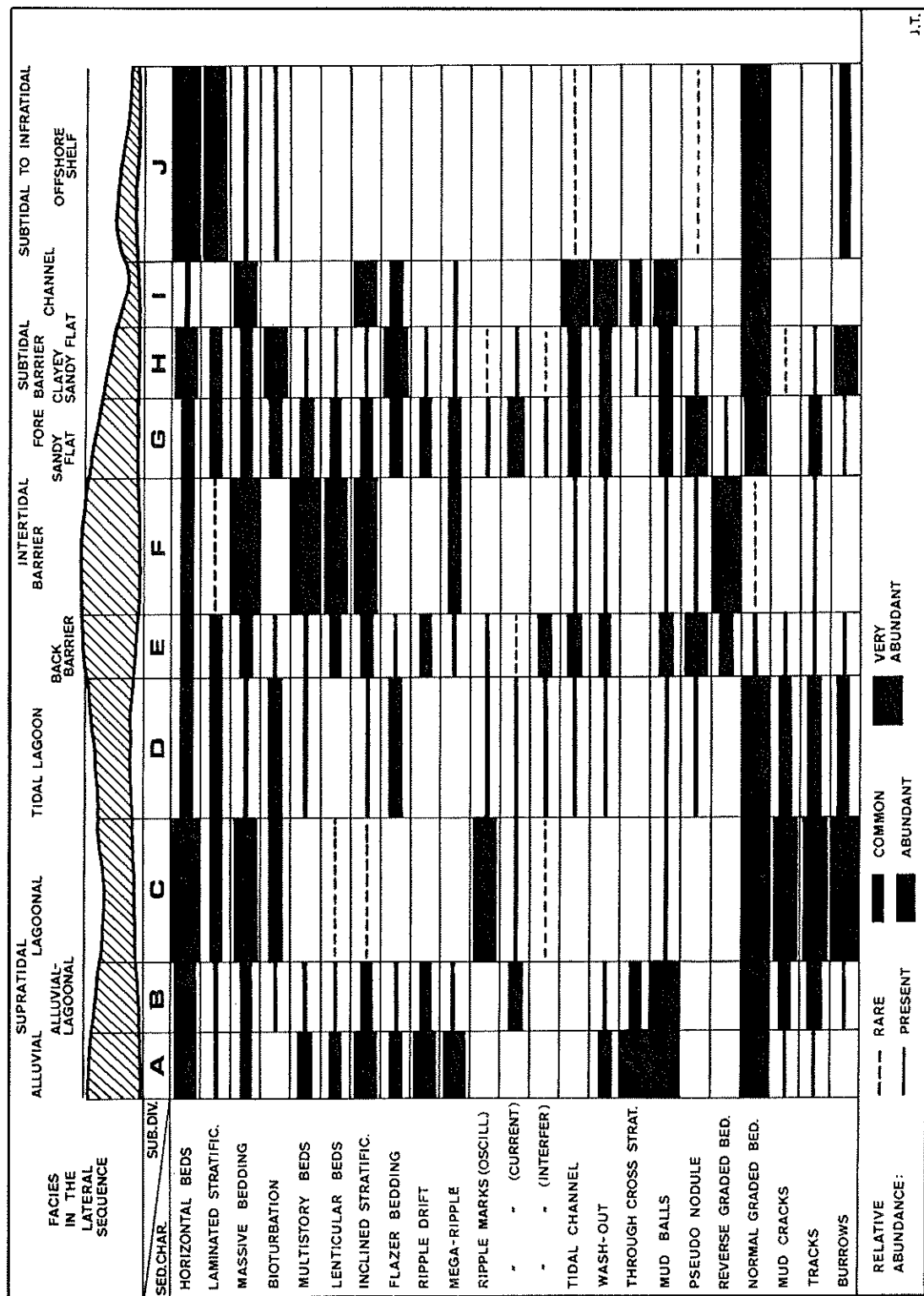


FIG. 16 — Schematic cross section with principal characteristics of the lateral sequence, showing relative abundance and distribution of sediments, fossils, graded bedding and the effect of sorting and energy



5.1.2. BRIEF REVIEW OF THE SEDIMENTARY ENVIRONMENT

A detailed survey of more than 75 outcrops in the Dinant Synclinorium has shown that the classical "Assises de Montfort et d'Evieux" are characterized by a rhythmic sedimentation, in which major and minor rhythms can be distinguished. The more or less continuous lateral extension of the major rhythms through the different areas, which have been studied is also a rather conspicuous element. The succession of sedimentary structures within these different rhythms in time and space is an obvious response to the changing paleogeographic conditions.

For the purpose of this chapter, some general characteristics of the sedimentation are briefly reviewed.

Minor rhythms (from a few decimeters up to two-four meters thick) may vary in their lithological evolution, in the associated sedimentary structures and in the type of graded bedding. Some of the most common types of minor rhythms are schematically shown in figures 14 and 15. Three types of graded bedding, "reverse", "normal" and "cyclic reverse-normal", occur within the minor rhythms. As shown in figures 14 and 16, the type of graded bedding is controlled by the place of the rhythm in the ideal lateral sequence. Because of the fact that the detrital skeleton grains are usually well sorted it is easy to follow any variations in the graded bedding step by step in each rhythm or in its components by analysing the basal, medial and upper parts of it. These three types of graded bedding have been observed in more than one thousand rhythms. Figures 14-18 show the variation of lithofacies in minor rhythms related to their place in the ideal lateral sequence.

Minor rhythms are combined into larger units or major rhythms (fig. 18). They consist of two phases ("doublet"), reflecting specific trends of the composing minor rhythms, namely a lower mainly arenaceous phase (LPAP) and an upper complex phase (UCP). This subdivision is also observed at the level of the grain size distribution: reverse, normal and/or "cyclic" in the minor rhythms, and *grosso modo* "cyclic" reverse-normal or normal in the major rhythm from bottom to top. Of course, also other variations have been recognized in the basin.

Major rhythms can be correlated from one outcrop to another. In the Ourthe valley — where 32 quarries and natural outcrops have been investigated —, these correlations could be checked by the occurrence of marker beds and by the abundant biostratigraphical data (spores, conodonts, ostracodes).

Taking into account the lateral variation within the rhythms and the succession in which they occur it is possible to reconstruct the ideal lateral sequence of deposits with their corresponding specific minor

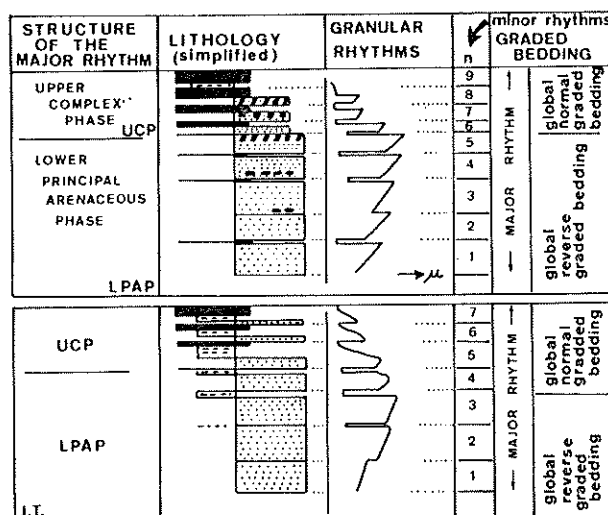


FIG. 18 — Principal characteristics and general trend in the major rhythmic sedimentation. Major rhythms can be subdivided into an upper complex phase (UCP) and a lower (mainly arenaceous) phase (LPAP). Each of these comprises several minor rhythms with characteristics (graded bedding evolution and lithofacies) reflecting the same development of the major rhythms. For example the above figured rhythm is related to a back-barrier tidal lagoon facies at the LPAP-level; the UCP is more closely related to a lagoonal (evaporitic) facies with some residual tidal lagoon influences. It is to be noted that during the LPAP dolomite has been precipitated, reworked, transported and finally has settled down with micas and/or clay introduced in the lagoonal back-barrier facies by tidal currents. The second major rhythm shows an increase of the relative amount of clay. Compare also the grading of the grain size at the level of the major rhythm with that at the level of minor rhythmic components. Other, non-figured major rhythms occur in the basin, some of these showing a fining-up of the grain size

rhythms, sedimentary structures and grain size distributions (fig. 14-17). This method allows us to relate each specific rhythmic pattern to a peculiar environment, such as alluvial, alluvio-lagoonal, evaporitic lagoonal, tidal lagoonal, back barrier, barrier and fore barrier facies. Or we may use the terminology for tidal flat areas: supratidal, intertidal, subtidal and infratidal. In some areas, there occur also turbiditic and offshore clay deposits. Once having translated each sediment into its corresponding facies, we are also able to interpret the relative position of incomplete rhythms in this idealized scheme. Of course, all kinds of intermediate nuances between the ideal rhythms exist, and they may occur both in time and in space. The datum "time" has not been taken into account in our figures.

The lateral and vertical succession and interfingering of the predominant sedimentary rhythms within the Ourthe valley is shown in fig. 19A. These predominant rhythms determine the mega-facies, which will have reigned on a given place at a given time. This does not imply, however, that no rhythms characteristic of a different mega-environment may occur in that succession. Fig. 19A is therefore a rather sim-

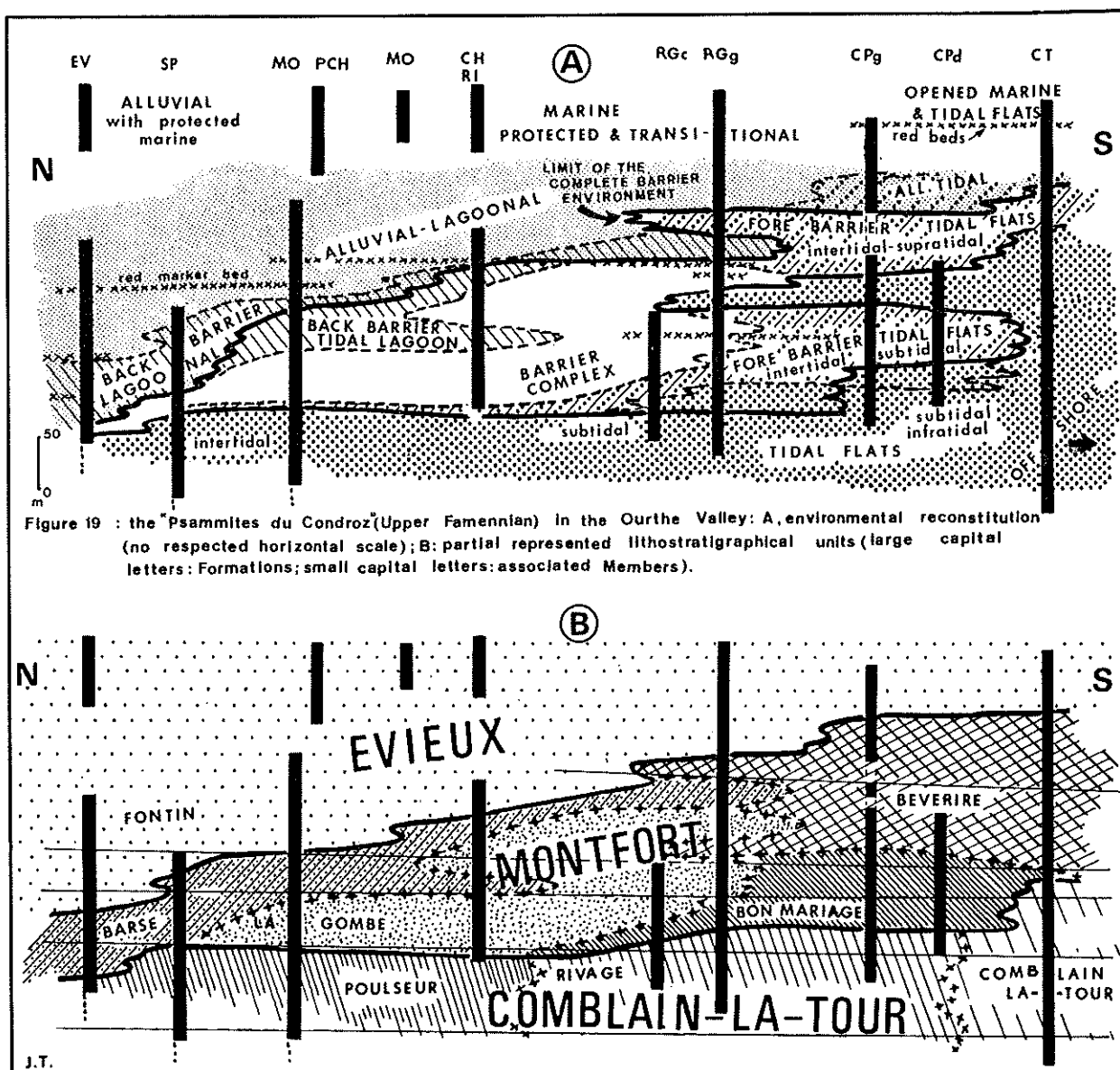


FIG. 19 — Cross sections through the Upper Famennian of the Ourthe valley.
 A: simplified environmental reconstruction of the megafacies. The vertical black lines show the relative position of the investigated sections. No horizontal scale has been adopted. The sinuous black line borders the barrier complex s.s. with its ideal components back barrier, barrier complex s.s. and fore barrier.
 B: schematic distribution of the lithostratigraphic units (formations and members) in the same area. The interfingering pattern of these units has been largely simplified. The graph shows the Montfort Formation and parts of the Evieux and Comblain-la-Tour Formations

plified representation of the much more complex reality, that can be observed in the field. Nevertheless, there has existed a relative stability of environmental conditions within a specific area and during a relatively long period. The most important control of the sedimentary facies has been the hydrodynamic energy level (currents, tidal currents and wave action). Nuances in the energy-level are reflected by nuances in the minor and major rhythms. These complications cannot be shown, however, at the scale of fig. 19.

5.1.3. LITHOSTRATIGRAPHY

As a direct result of this study, we have to reconsider our concept of the lithostratigraphy of the "Psammities du Condroz", particularly in their type locations of the Ourthe valley (THOREZ 1973, 1975). This implies, that the former "Assises de Montfort et d'Evieux" of MOURLON (1885) are to be replaced by a new subdivision into formations and members. The diagnostic features of these formations (Comblain-la-

Tour, Montfort and Evieux Formations with their corresponding members, fig. 19B) will be given in another paper (THOREZ 1975). As already pointed out by BOUCKAERT, STREEL & THOREZ (1968), these lithostratigraphical units are strongly diachronic and reflect a general regression of the Upper Famennian sea in the Eastern part of the Dinant Synclinorium. This diachronism of the megafacies has been proven by biostratigraphical investigations on spores and conodonts. The distribution of other microfossil groups as acritarchs and ostracodes appears to have been mainly controlled by these mega-environments. Therefore, these fossils are less suitable for biostratigraphical studies within the Upper Famennian.

5.2. LATERAL DISTRIBUTION OF OSTRACODES

(M. J. M. BLESS & J. THOREZ)

(Enclosure I, fig. 20)

The contents of 97 ostracode samples, in age ranging from Fa2a to Tn2c, has been analyzed for paired occurrences of 22 ostracode species and species-groups. The coefficient of JACCARD has been used for the recognition of such occurrences. This coefficient is rarely used in paleontology. But CARBONNEL (1969) successfully demonstrated its use for Miocene ostracode assemblages even when a simplified form of this coefficient is accepted. Although there may exist several mathematical problems, which make this method less reliable than other ones, it must be admitted that it is about the easiest one to use when no sophisticated calculating-machine is available to do the job of computing 231 possible paired occurrences.

CARBONNEL (1969) accepted the following form of the coefficient of JACCARD:

$$J = \frac{a}{a + b + c}$$

where a is the number of joint occurrences of species B and C, b is the number of occurrences of species B without C, and c is the number of occurrences of C without B. Following CARBONNEL, we have accepted $J = 0.25$ as the cut-off value for a weak joint occurrence of two species. $J = 0.40$ has been accepted as the cut-off value for a relatively strong joint occurrence. The pro's and contra's of any chosen value has been sufficiently discussed by CARBONNEL (1969) and BLESS & WINKLER PRINS (in VAN AMEROM *et al.*, 1970). Only species or species-groups, which occurred in a minimum of five samples have been taken into account.

Four ostracode assemblages have been recognized (Enclosure I). The first one, assemblage I, is characterized by the joint occurrence of smooth-shelled pod-

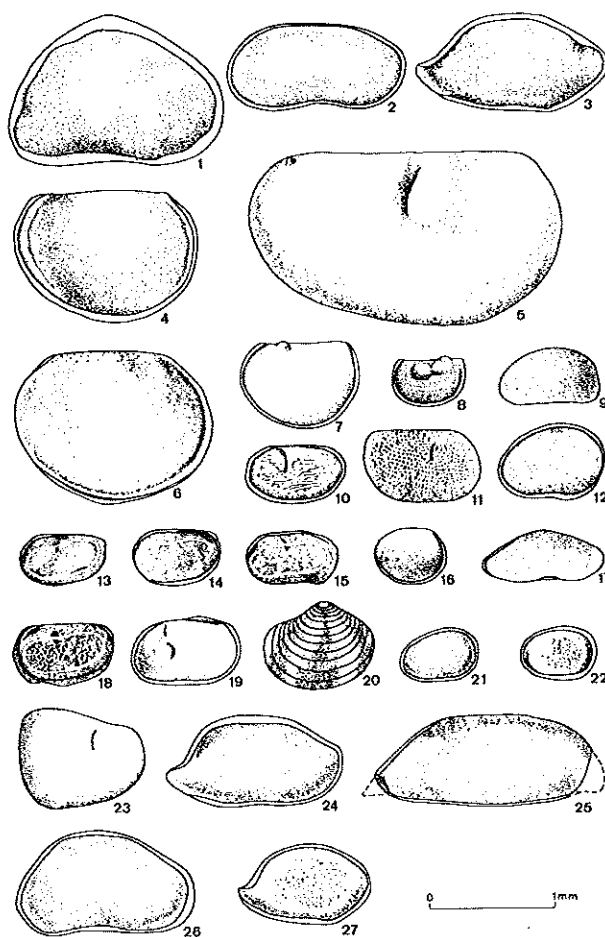


FIG. 20 — Legend to Enclosure I

1 = *Bairdiocypris* aff. *rudolphi* (KUMMEROW 1939); 2 = *Bairdiocypris* aff. *robusta* KUMMEROW 1939; 3 = *Bairdia* spp.; 4 = *Shemonaella* spp. 65 and 66; 5 = "*Bernix*" *venulosa* KUMMEROW 1939; 6 = *Shemonaella*? sp. cf. 66; 7 = *Shishaella* aff. *porrecta* (ZANINA 1956); 8 = *Kellettina acutibata* (ROME 1971); 9 = *Pseudobythocypris planoventralis* ROME 1971; 10 = *Knoxiella* spp.; 11 = *Knoxiella* cf. *complanata* (KUMMEROW 1939); 12 = *Cavellina coela* (ROME 1974); 13, 18 = *Beyrichiopsis glyptopleuroides* GREEN 1963; 14 = *Beyrichiopsis* sp. 47; 15 = *Beyrichiopsis* sp. 46; 16 = *Bouchekius* cf. *rotundus* ROZHDESTVENSKAJA 1972; 17 = *Bairdia* (*Cryptobairdia*) sp. 128; 19 = *Sulcella* sp. 44; 20 = *Cryptophyllus* spp.; 21 = *Cavellina* aff. *coela* (ROME 1974); 22 = *Cavellina* sp. 34; 23 = *Indivisia* aff. *variolata* ZANINA 1960; 24 = *Bairdia* aff. *povorinensis* SAMOILOVA 1970; 25 = *Acratia* cf. *evlanensis* EGOROV in POLENOVA 1953; 26 = *Bairdiocypris* sp. 32; 27 = *Bairdia* aff. *kelleri* EGOROV in POLENOVA 1953

copid genera: *Bairdia*, *Bairdiocypris* and *Acratia*. This assemblage occurs in the middle and upper nodular limestones of the so-called Souverain-Pré facies of the Ourthe valley. This assemblage is restricted to the Fa2a. The Souverain-Pré facies is believed to represent a relatively deep subtidal environment. Reworked pebbles of these nodular limestones occasionally occur in the basal parts of the barrier complex environment (e.g. in section of Souverain-Pré, Enclosure I).

The second assemblage, assemblage II, is characterized by only one small punctate cavellinid ostracode, here identified as *Cavellina* sp. 34. The species is rather abundant when it occurs, other ostracode species being either absent or present in small numbers. This assemblage occurs in thin limestone beds of the so-called Comblain-la-Tour facies of the Ourthe valley. This assemblage is restricted to the top of the Fa2a and Fa2b (spore zones GMi to GMs). The limestones of the Comblain-la-Tour facies are believed to represent an intertidal environment.

The third assemblage, assemblage III, is the largest one, characterized by at least three species of *Cryptophyllus*, three species of *Knoxiella*, three species of *Beyrichiopsis*, two species of *Shemonaella*, *Cavellina* aff. *coela* and *Sulcella* sp. 44. Except for *Shemonaella* and *Cavellina*, these are all weakly ornamented ostracodes. Several other ostracode species belonging to the genera *Bouchekius*, *Monoceratina* and *Kloedenellitina* occasionally occur. Beyrichiacean ostracodes may also be present. Assemblage III occurs in thin cryptitic limestones and dolomitic lenses of the Evieux facies (Chanxhe and Fontin members), which is believed to represent an supratidal environment transitional to an open marine environment. Assemblage III predominates during the Fa2c.

The fourth and least assemblage, assemblage IV, is characterized by large or relatively large, practically smooth-shelled ostracodes belonging to the genera *Bairdia*, *Bairdiacypris*, *Bairdiocypris*, *Shemonaella*, *Shishaella* and "Bernix". *Acratia*, *Kummerowia* and *Uchtozia* are among the less frequent associated genera. This assemblage characterizes the crinoidal limestones of the Comblain-au-Pont facies, which represents again a relatively deep subtidal environment. Assemblage IV characterizes the sediments of the Fa2d and Tn1-2 of the Ourthe valley and occurs also in the Tn2 of the Namur Basin. In the southwestern part of the Dinant Basin, assemblage III existed during the Famennian and Tournaisian period.

The cryptitic limestones of the Tn1 (Tn1a? and Tn1b) of the Namur Basin have yielded an impoverished assemblage III, predominated by the genera *Knoxiella*, *Shemonaella*, *Cavellina* and *Pseudobythocypris*. Accompanying genera being *Cryptophyllus*, *Beyrichiopsis* and *Kellettina* in the lower part of the sections at Feluy and Onoz (cf. BECKER & BLESS 1974, appendix 2). Although we do not have detailed information on the sedimentary facies of the Tn1 of the Namur Basin, we suggest that these cryptitic limestones have been deposited in a lagoonal, supratidal environment similar to that of the Fa2c of the Ourthe Basin. The main difference between these two areas (Namur Basin and Ourthe valley) may have been that the C'-facies predominated in the infratidal environment of the Namur Basin because of less influx of clastic material in that area.

5.3. CONCLUSIONS

(M. J. M. BLESS, M. STREEL & J. THOREZ)

The symbiosis of detailed paleontological and sedimentological analysis of the Upper Famennian in the Ourthe valley has resulted in the recognition of four main sedimentary environments with their corresponding ostracode communities and acritarch assemblages. It should be stressed, that the sedimentary, palynological and ostracode studies have been carried out independently of each other. It was not before the final results of each of these investigations were known, that they have been compared. This is considered as an important argument for the reliability of the applied methods.

In ascending stratigraphic order we may distinguish:

1. The subtidal environment (environment I) with nodular limestones of the basal Upper Famennian (the *Palmatolepis* m. *marginifera* zone by conodonts). Ostracodes are quite common. They belong to the *Bairdia*-*Acratia*-*Bairdiocypris* assemblage (assemblage I). Neither spores nor acritarchs have been recovered from this facies. The nodular limestone facies gradually merges into:

2. The intertidal fore-barrier environment, which has been subdivided into two minor sedimentary facies — H and I — where clastic sediments (sands, clayey sands and pelitic material) predominate over isolated patches of cryptitic and organoclastic limestones. Ostracodes are relatively scarce. The majority of specimens belongs to a single species — *Cavellina* sp. 34 —, which is characteristic for assemblage II. The acritarch assemblage c, characterized by the relative frequency of *Lophosphaeridium* sp., has been recognized in several samples.

3. The barrier complex s.l. is the third sedimentary environment. It consists of two minor intertidal facies (G and F) and one supratidal facies E. Here, coarse grained sands with often cross-bedded strata and slump structures predominate. Presumably, no ostracodes can have survived in this high-energy environment.

In the more protected back-barrier and tidal lagoon environments, acritarchs of assemblage b with frequent *Gorgonisphaeridium* sp. occur.

4. The barrier complex s.l. has clearly separated the intertidal fore-barrier environment, where wave action has played an active role, from the more protected low-energy supratidal environments C and D, where evaporitic dolomites and — less frequently — cryptitic limestones constitute an important element of the sediments, indicating respectively lagoonal and restricted marine conditions. A rather rich and diversified ostracode fauna occurs, characterized by several species of *Knoxiella* and *Beyrichiopsis* (assemblage

III). Because of the alluvial influence in this environment, there occurs only an impoverished acritarch assemblage (assemblage a) consisting of two or three species. When there is a transition of supratidal towards more subtidal and open marine facies, a more diversified assemblage (assemblage b') occurs, characterized by the presence of *Gorgonisphaeridium winslowi*. The alluvial influence in the supratidal facies is also indicated by the relative frequency of spore-tetrads.

The above sequence of subtidal through intertidal into supratidal environments during the Upper Famennian is without doubt indicative for a regressive phase of the Devonian sea in this region. During final Famennian times a renewed transgression has occurred, which resulted again in subtidal to open marine conditions all over the area with coarse organoclastic limestones, which practically persist during the whole Dinantian. The ostracode assemblage IV with *Bairdia*, *Bairdiacypris* and *Bairdiocypris* recalls assemblage I from the

subtidal to open marine Souverain-Pré facies at the beginning of the Upper Famennian. The most important difference is, that the elongate ostracode genus *Acratia* has been replaced by the elongate genus *Bairdiacypris* of presumably the same family. In contrast to the Souverain-Pré facies, acritarchs occur in the subtidal to open marine facies of the Tournaisian (assemblage d), the relative abundance of *Gorgonisphaeridium winslowi* being the most important element of the acritarch assemblage.

Diachronism of the above environments is now well known for the Upper Famennian strata of the Ourthe valley. This does not imply, however, that this phenomenon is restricted to that area. In contrary, distribution of subtidal and supratidal ostracode assemblages (resp. assemblages I, IV and III) in the Upper Famennian and Tournaisian of Belgium shows, that from the Fa2c onwards an overall transgression along the borders of the Brabant Massif has taken place.

6. REFERENCES

Most of the references concerning ostracodology have been already cited in BECKER & BLESS (1974) and are accordingly largely omitted here. The same holds for most references on palynology, which have been previously cited by STREEL (1964, 1965, 1966, 1967, 1968, 1969, 1971 and 1972).

The abbreviation B.S.T. has been used for BOUCKAERT, STREEL & THOREZ; B.S.T.M. for BOUCKAERT, STREEL, THOREZ & MOUND; S., W. & B. for SCHOPF, WILSON & BENTALL.

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Plates

PLATE 1

(scale = 1 mm; photographs H. FUNK, Frankfurt a. Main)

- Fig. 1, 2. Beyrichiacean ostracode sp. 100.
1: specimen HO39-SMFXe9586, lateral and ventral views of heteromorphic RV;
2: specimen HO40-SMFXe9589, lateral and ventral views of tectomorphic RV, shell partly removed in order to show interior of S2.
- Fig. 3. Beyrichiacean ostracode sp. 101.
Specimen HO31-SMFXe9581, heteromorphic ? RV.
- Fig. 4. Beyrichiacean ? ostracode sp. 102.
Specimen HO31-SMFXe9582, lateral and ventral views of tectomorphic LV. Note posterodorsal spine. A second, presumably heteromorphic specimen of the same species from sample MP13 has been lost during preparation.
- Fig. 5, 6. Beyrichiacean ostracode sp. 103.
5: specimen HO39-SMFXe9587, lateral and ventral views of heteromorphic LV;
6: specimen HO39-SMFXe9588, lateral and ventral views of tectomorphic LV. Note the obscure velar bend and the ornamentation of the crumina.

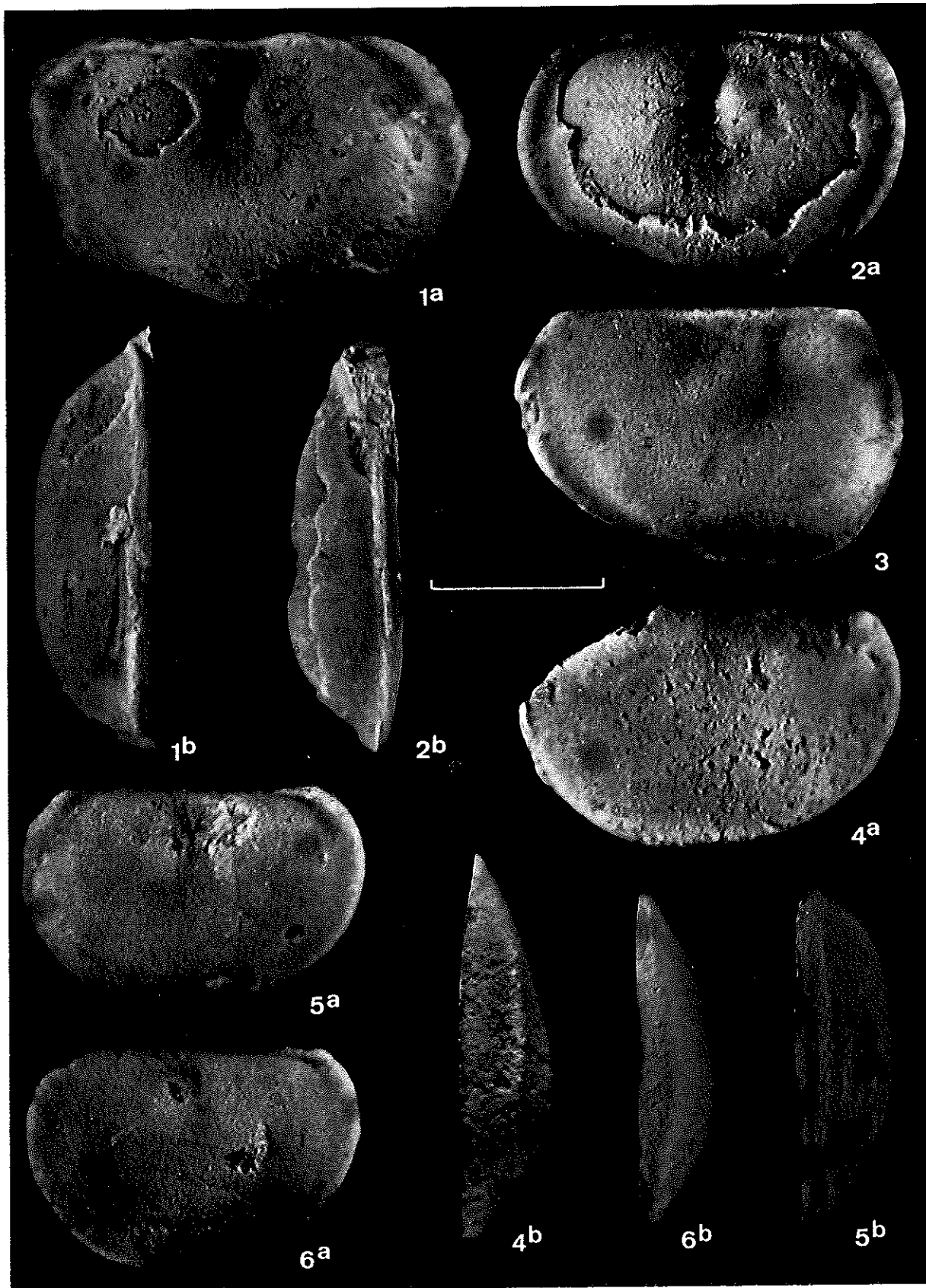


PLATE 2

(scale = 1 mm; photographs H. FUNK, Frankfurt a. Main)

- Fig. 1—4. *Beyrichiacean ostracode* sp. 104.
 1: specimen HO48-SMFXe9598, lateral view of heteromorphic RV;
 2: specimen HO48-SMFXe9599, lateral view of internal mold of tecnomorphic RV;
 3: specimen HO48-SMFXe9600, lateral view of internal mold of tecnomorphic RV;
 4: specimen HO48-SMFXe9601, lateral view of internal mold of tecnomorphic RV.
 The species is characterized by a large spinous I.3.
- Fig. 5. *Adelphobolbina* cf. *europaea* BECKER & BLESS 1971.
 Specimen HO31-9583, lateral view of tecnomorphic RV.
- Fig. 6. *Hollinella* vel *Adelphobolbina* sp. 105
 Specimen HO31-SMFXe9584, lateral view of RV.
- Fig. 7. *Podocopid ostracode* sp. 106.
 Specimen HO45-SMFXe9597, lateral view of single valve.
- Fig. 8. *Polytylites* sp. 107.
 Specimen HO31-SMFXe9585, lateral view of internal mold of RV. The external mold (lost during preparation) showed reticulate ornamentation.
- Fig. 9. *Knoxiella* sp. 108.
 Specimen HO41-SMFXe9593, lateral view of RV.
 cf. *Knoxiella domanica* ROZHDESTVENSKAJA 1972, from the Frasnian, Domankov Horizon, Bashkiria, U.S.S.R.
 cf. *Knoxiella? clathrata* KUMMEROW 1939, from the Viséan of Binsfeldhammer near Stolberg, Federal Republic of Germany.
- Fig. 10. *Hollinella (Kestlingella)* sp. 109.
 Specimen HO30-SMFXe9580, lateral view of tecnomorphic RV.
 cf. *H. (K.) lionica* BECKER & BLESS 1971, from the Middle Frasnian of Belgium and France.
- Fig. 11—13. *Glezeria belgica* (MATERN 1929).
 11: specimen IRBa8a, RV of topotypic specimen from MATERN's collections from Les Abannets, Belgium, Fr2e;
 12: specimen HO40-SMFXe9591, lateral view of RV;
 13: Holotype IRBa1a, Les Abannets, Belgium, Fr2e. The genus *Glezeria* has been erected by SHISHKINSKAIA (1968) for some "drepanellid" ostracodes from the Frasnian of the Volgograd area, U.S.S.R.

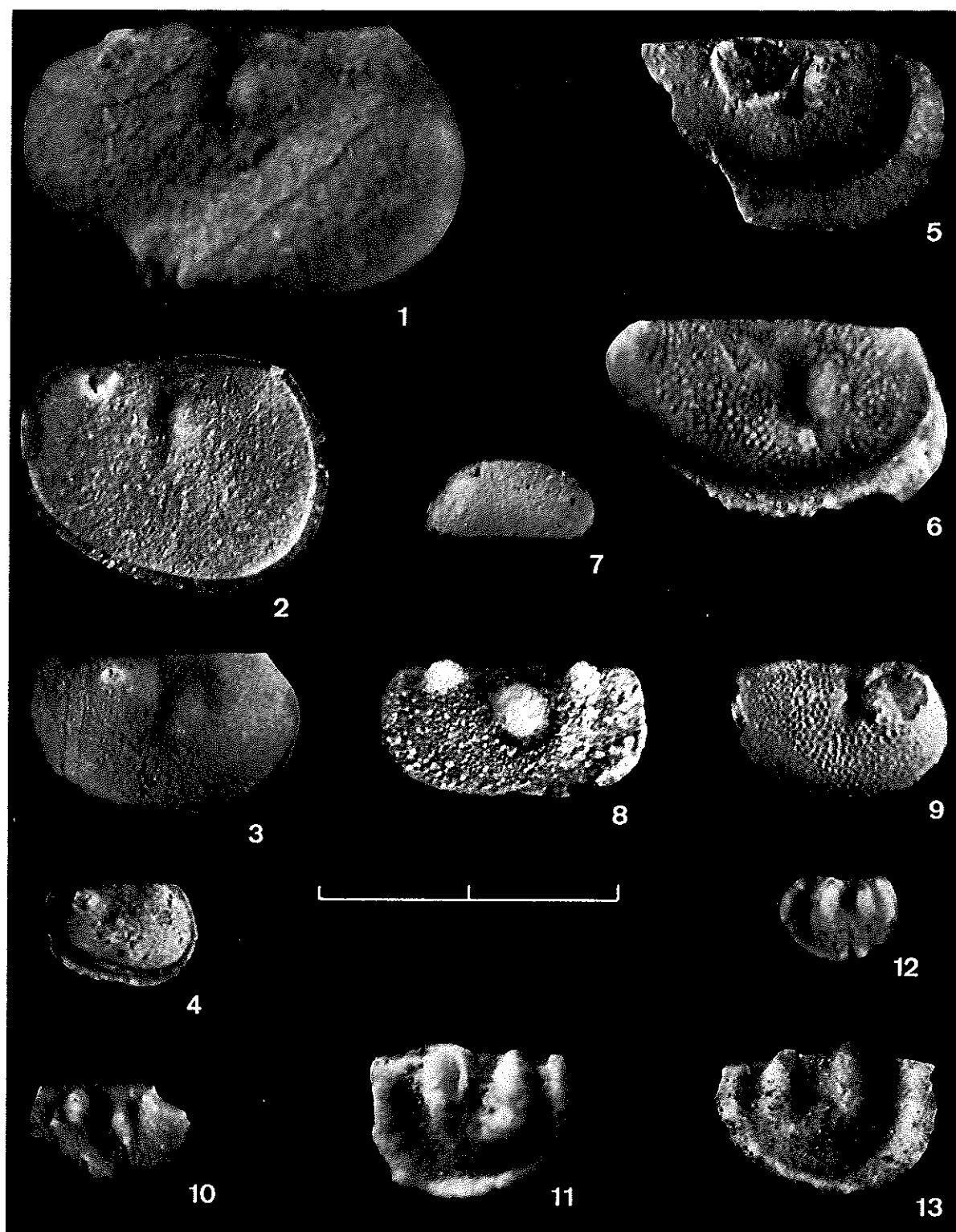


PLATE 3

(scale = 1 mm; photographs H. FUNK, Frankfurt a. Main)

- Fig. 1. *Ochescapha* ? sp. 110.
Specimen HO40-SMFXe9590, lateral and dorsal views of tectonomorphic LV. Note the posterodorsal spine in LV!
- Fig. 2. 3. *Ochescapha* ? *beckeri* GROOS 1969.
2: specimen HO45-SMFXe9595, lateral and dorsal views of tectonomorphic RV;
3: specimen HO45-SMFXe9591, lateral and dorsal views of heteromorphic LV.
This species is distinguished from *Ochescapha* ? sp. 110 by the presence of a posterodorsal spine in the RV, not in the LV.
- Fig. 4. *Kummerowia* n. sp. 113.
Specimen SE41-SMFXe9502, lateral, dorsal and ventral views of complete carapace.
? cf. *Paegnium* sp. A LETHIERS 1972 from the Fa1b?, Fa2a α and Fa2c, Dinant Basin, France.
- Fig. 5. Quasillitid sp. 112.
Specimen HO45-SMFXe9596, lateral and dorsal views of complete carapace.
- Fig. 6. *Richterina* (*Richterina*) *striatula* REINH. RICHTER 1848 (species 111).
Specimen SE41-SMFXe9504, lateral and ventral views of complete carapace.
cf. *Entomozoe* (*Nedhentomis*) *prolifera* (STEWART & HENDRIX 1945) sensu LETHIERS 1970, pl. XII, fig. 21 (non fig. 19, 20) from the top of the Middle Frasnian, Avesnois, France.
cf. *Richterina* n. sp. A LETHIERS 1972, pl. XXV, fig. 53, from the "Schistes de Matagne" (Fr3) of Senzeilles, France.
- Fig. 7. *Cryptophyllus* cf. sp. 17 BECKER & BLESS 1971.
Specimen HO40-SMFXe9592, lateral view of single valve.

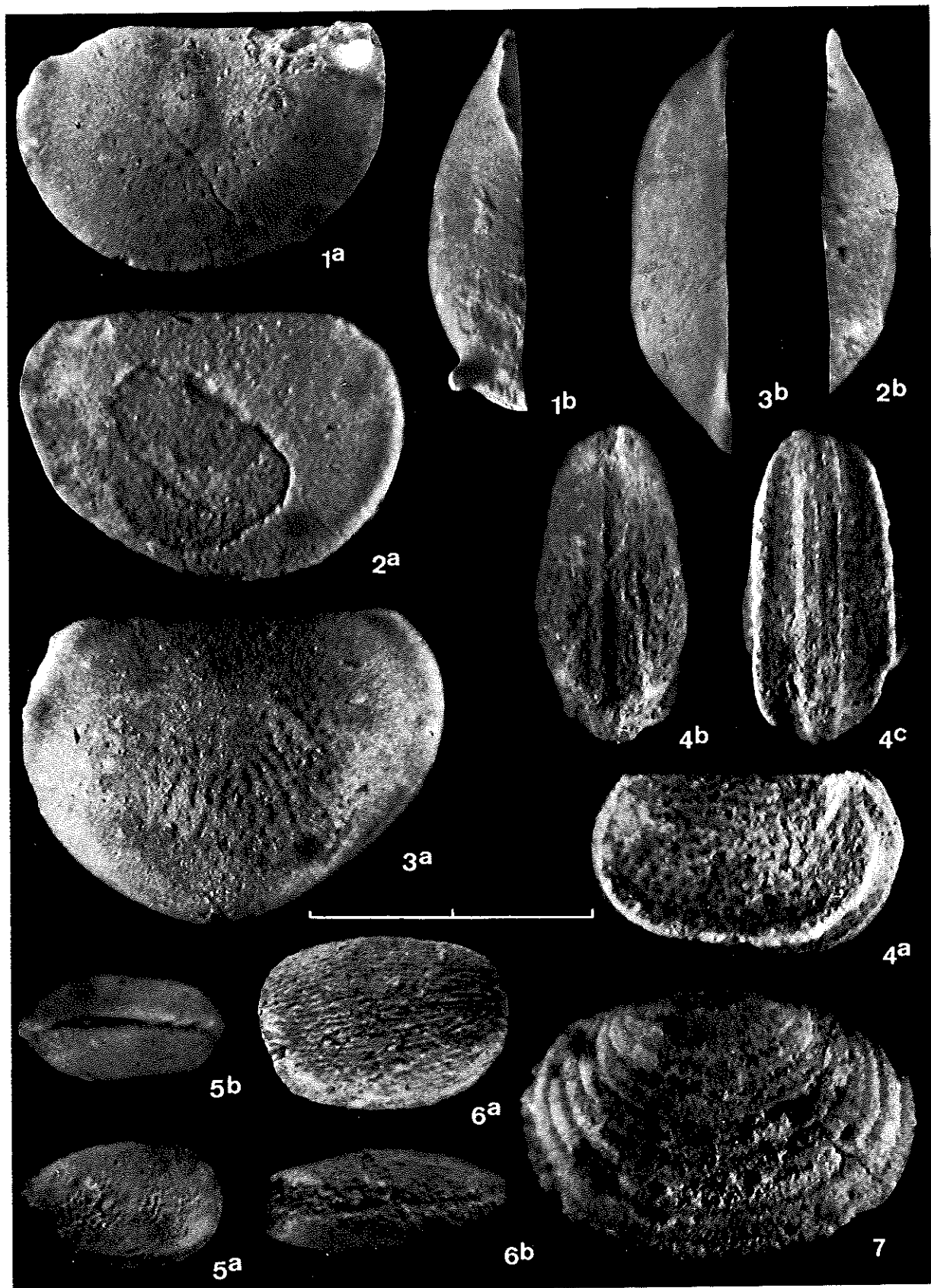


PLATE 4

(scale = 1 mm; photographs H. FUNK, Frankfurt a. Main)

- Fig. 1. *Knoxiella* sp. 114.
Specimen MP13-SMFXe9605, lateral view of RV.
- Fig. 2, 4. *Punctomosea* sp. 115.
2: specimen MP16-SMFXe9607, lateral and dorsal views of complete carapace;
4: specimen MP14-SMFXe9606, lateral view of complete carapace.
- Fig. 3, 5, 6. *Bairdiocypris* aff. *rudolphi* (KUMMEROW 1939) (= *B.* sp. 31 BECKER & BLESS 1974).
3: specimen MP19-SMFXe9609, lateral and dorsal views of juvenile carapace;
5: specimen MP19-SMFXe9608, lateral and dorsal views of juvenile carapace;
6: specimen MP20-SMFXe9619, lateral and dorsal views of complete carapace.
- Fig. 7, 9. *Bairdia* (*Bairdia*) sp. 116.
7: specimen SE41-SMFXe9603, lateral and dorsal views of complete carapace;
9: specimen MP21-SMFXe9621, lateral and dorsal views of complete carapace.
- Fig. 8. *Cryptophyllus* cf. *materni* (BASSLER & KELLETT 1934).
Specimen MP20-SMFXe9620, lateral view of complete carapace.

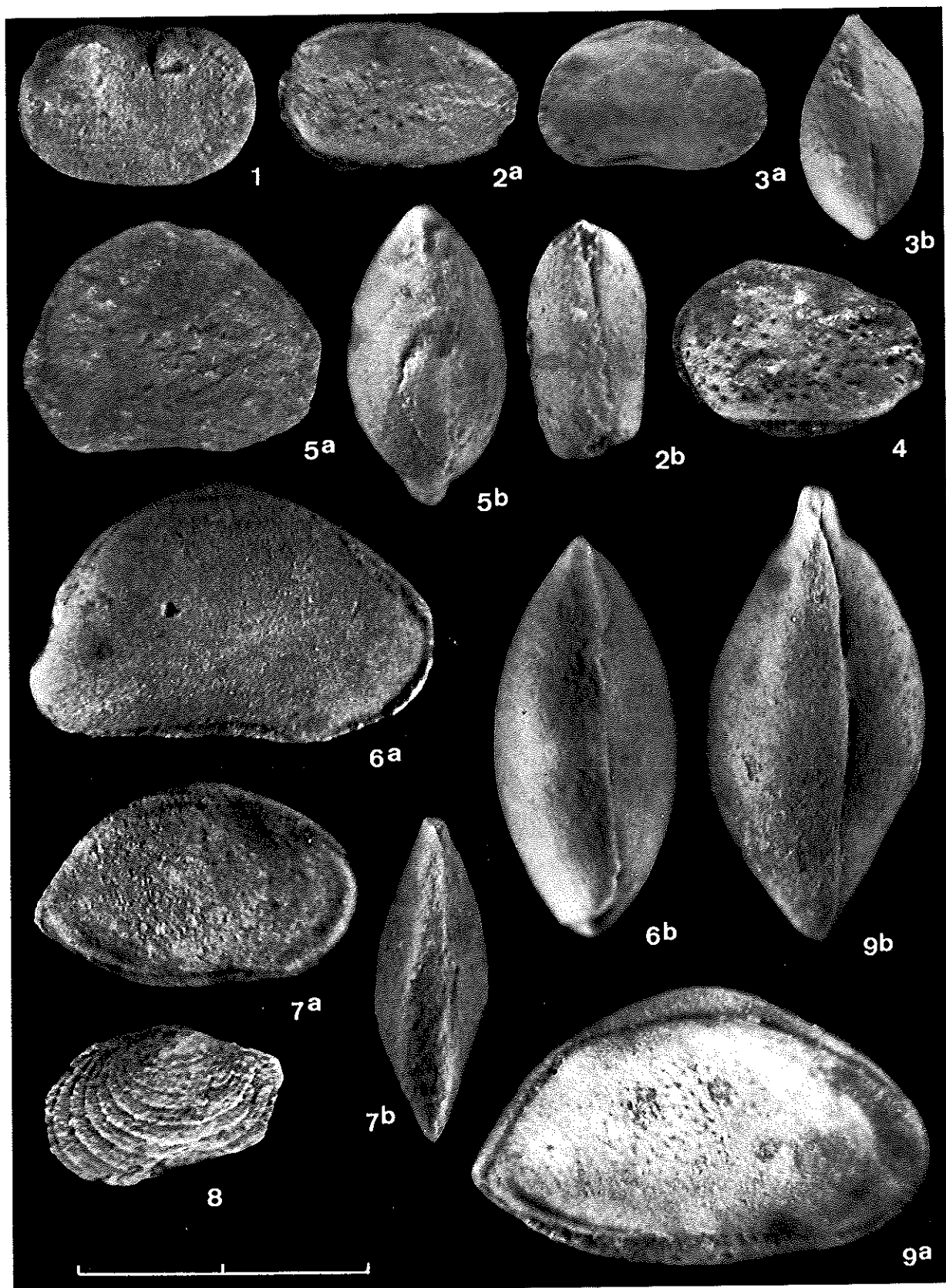


PLATE 5

(scale = 1 mm; photographs H. FUNK, Frankfurt a. Main)

- Fig. 1. 3. *Acratia* cf. *evlanensis* EGOROV in POLENOVA 1953 (= *A.* sp. 21 BECKER & BLESS 1974).
1: specimen MP19-SMFXe9617, lateral view of adult carapace;
3: specimen MP19-SMFXe9616, lateral and dorsal views of complete carapace.
- Fig. 2. *Microcheilinella* sp. 117.
Specimen MP19-SMFXe9610, lateral and dorsal views of carapace.
- Fig. 4. *Bairdia* (*Bairdia*) sp. 116.
Specimen MP19-SMFXe9611, lateral and dorsal views of complete carapace.
- Fig. 5. cf. *Bairdia* (*Bairdia*?) aff. *kelleri* EGOROV in POLENOVA 1953 (cf. *B.* sp. 24 BECKER & BLESS 1974).
Specimen MP19-SMFXe9618, lateral view of RV.
- Fig. 6. *Bairdia* (*Rectobairdia*) cf. *pajfrathensis* KUMMEROW 1953.
Specimen MP19-SMFXe9612, lateral and dorsal views of complete carapace.
- Fig. 7. *Acratia* aff. *supina* POLENOVA 1953 (= *A.* sp. 22 BECKER & BLESS 1974).
Specimen MP19-SMFXe9615, lateral and dorsal views of complete carapace.
- Fig. 8. *Bairdiacypris irregularis* (POLENOVA 1953).
Specimen MP19-SMFXe9614, lateral and dorsal views of complete carapace. POLENOVA's specimens come from the Voronezh, Evlanov and Livny strata of the Voronezh, Orel and Saratov regions, U.S.S.R.
- Fig. 9. *Bairdiacypris* cf. *quarziana* (EGOROV in POLENOVA 1953).
Specimen MP19-SMFXe9613, lateral and dorsal views of complete carapace. POLENOVA's specimens come from the Voronezh, Evlanov and Livny strata of the Voronezh and Saratov regions, U.S.S.R.

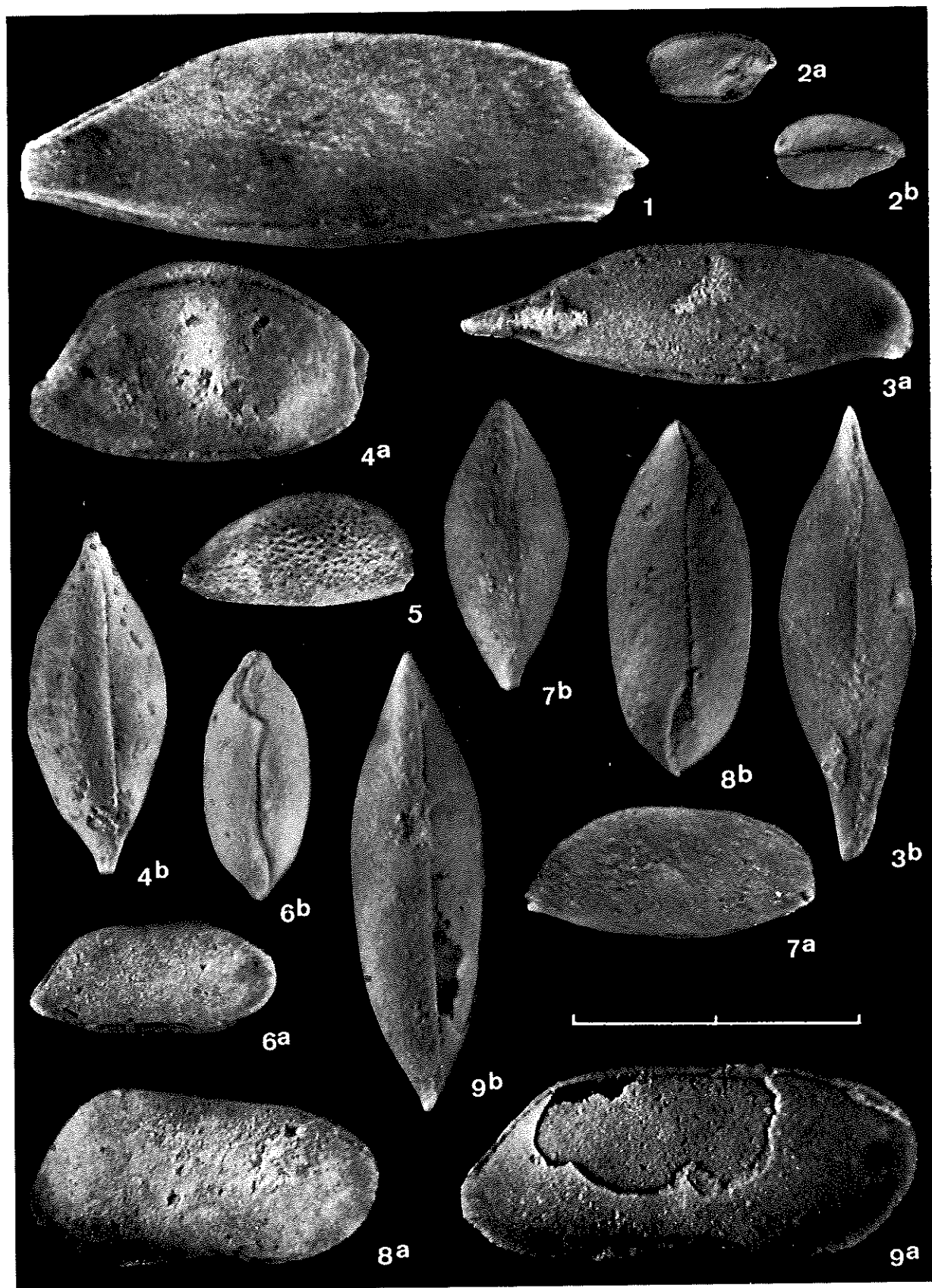


PLATE 6

(scale = 1 mm; photographs L. R. FUNCKEN, Heerlen)

Fig. 1—6, 8—10. *Beyrichiopsis glyptopleuroides* GREEN 1963 (= *Glyptolichwinella* aff. *chovanensis* sensu GUREVICH sensu BECKER & BLESS 1974, species 45).

- 1: specimen Fe4a-7, lateral view of complete carapace with relatively coarse reticulation;
- 2: specimen RG13-27, dorsal and lateral views of complete carapace with coarse reticulation;
- 3: specimen FL42a-18, single valve with coarse reticulation;
- 4: specimen FL42a-19, single valve with coarse reticulation;
- 5: specimen FL42a-28, dorsal and lateral views of complete carapace with fine reticulation-punctuation;
- 6: specimen FL42a-32, lateral and ventral views of complete carapace with relatively fine reticulation-punctuation;
- 8: specimen EV30a-40, dorsal and lateral views of complete carapace with part of flange preserved, relatively coarse reticulations within annular ridge and fine reticulation between annular ridge and margins of valves;
- 9: specimen EV30a-38, single valve with remnants of flange, double reticulation within annular ridge and fine reticulation between ridge and margins;
- 10: specimen EV30a-39, dorsal and lateral views of complete carapace with fine reticulation-punctuation;
- 11: specimen EV30a-45, single valve with fine reticulation-punctuation.

Fig. 7. *Beyrichiopsis* sp. 46 (BECKER & BLESS 1974).
Specimen CPd30-10, single valve.

Fig. 12, 13. *Beyrichiopsis* sp. 47 (BECKER & BLESS 1974).
12: specimen EV30a-44, dorsal and lateral views of complete carapace;
13: specimen EV30a-37, single valve.

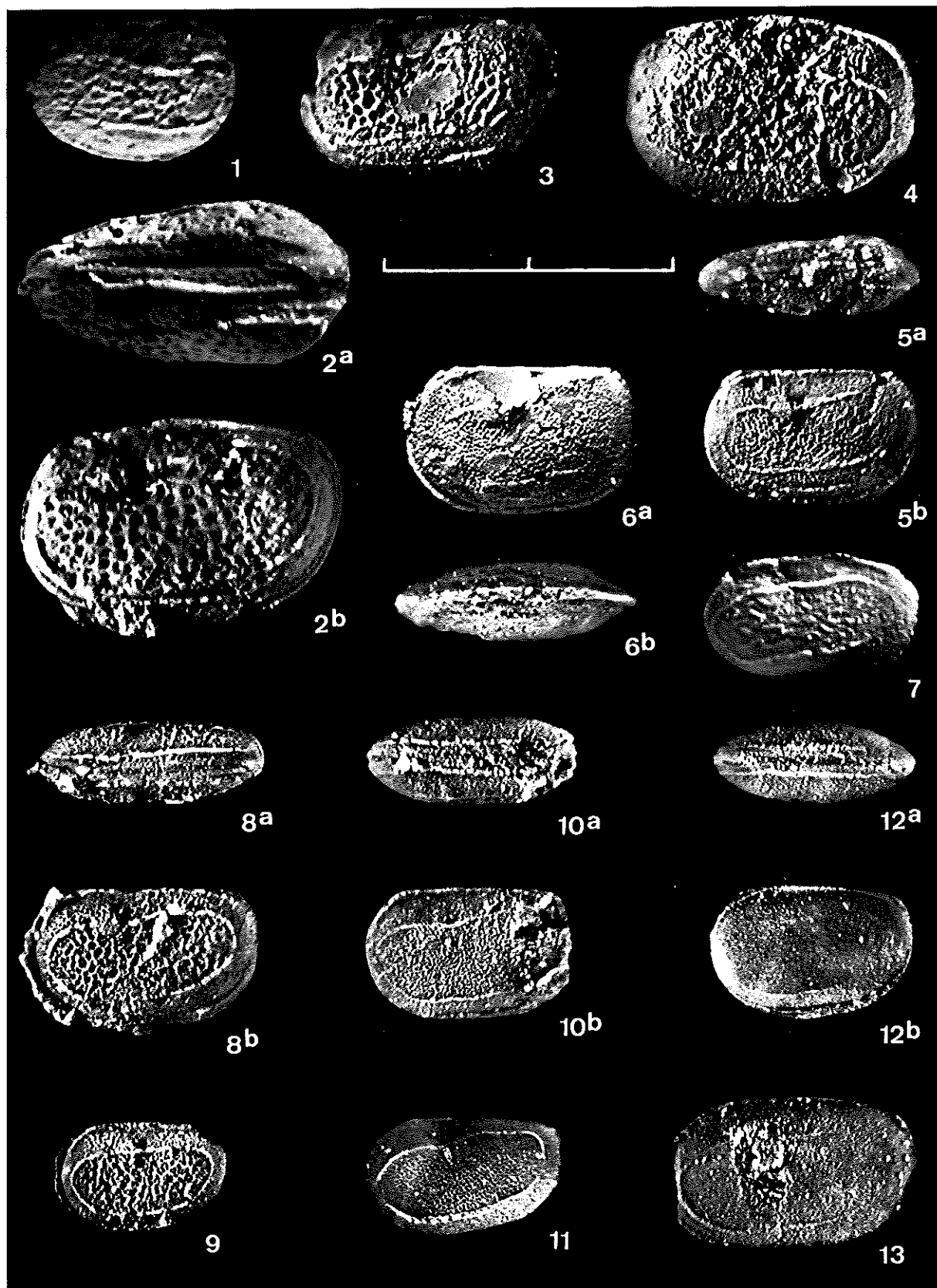


PLATE 7

(scale = 1 mm; photographs L. R. FUNCKEN, Heerlen)

- Fig. 1. *Sulcella* sp. 44 BECKER & BLESS 1974.
Specimen EV30a-25, dorsal and lateral views of complete heteromorphic carapace.
- Fig. 2. *Knoxiella* sp. 49 BECKER & BLESS 1974.
Specimen EV33-40, dorsal and lateral views of complete carapace.
- Fig. 3. *Bouchekius* cf. *rotundus* ROZHDESTVENSKAJA 1972 (species 129).
Specimen FL42a-10, lateral and ventral views of complete carapace. ROZHDESTVENSKAJA (1972) described an ostracode species with similar shape and size as our species from the Dankov and Zavolsk strata of Bashkiria, Tataria, Orensburg and Voronezh regions, U.S.S.R. The same species has also been recognized in samples CH11 and MO38.
- Fig. 4. *Cavellina* aff. *coela* (ROME 1974) (= *Cavellina* sp. 35 BECKER & BLESS 1974).
Specimen EV30-51, dorsal and lateral views of complete female carapace.
- Fig. 5. *Pseudobythocypris planoventralis* ROME 1971.
Specimen FE4b-58, dorsal and lateral (right valve) views of complete carapace.
- Fig. 6. Parodomellid? ostracode sp. 94 BECKER & BLESS 1974.
Specimen FE6-37, dorsal and lateral views of complete carapace. Note deeply incised dorsum!
- Fig. 7. *Cavellina coela* (ROME 1974) (= *Cavellina* sp. 36 BECKER & BLESS 1974).
Specimen FE4b-23, dorsal and lateral views of male carapace.
- Fig. 8. *Monoceratina* sp. 118.
Specimen EV33-9, dorsal, lateral and ventral views of complete carapace. Because of its small size, this may be a juvenile specimen. Species characterized by reticulate surface ornamentation and low, blunt ventral spines, which are degenerated into little more than slightly inflated areas.
- Fig. 9. *Shemonaella*? sp. cf. 66 BECKER & BLESS 1974.
Specimen C455/15-3, dorsal and lateral views of complete carapace.
cf. *Chamishaella kaisini* ROME 1974.



PLATE 3

(scale = 1 mm; photographs L. R. FUNCKEN, Heerlen)

- Fig. 1. *Bairdia* (*Bairdia*) sp. 119.
Specimen SP1a-37, dorsal and lateral views of complete carapace.
cf. *Bairdia* sp. BUSHMINA 1970, p. 46, pl. 13, fig. 3, from the Tournaisian of the
Lena River area, U.S.S.R.
- Fig. 2, 3. Bairdiid ostracode sp. 121.
2: specimen SP1b-27, dorsal and lateral views of complete carapace;
3: specimen SP1b-28, dorsal and lateral views of complete carapace.
cf. *Acratia gruendeli* ROZHDESTVENSKAJA 1972 from the Famennian of Bashkiria and
Tartarian regions, U.S.S.R. Our species is considerably more inflated, however, than
A. gruendeli. But we feel that there may be close affinity.



PLATE 9

(scale = 1 mm; photographs L. R. FUNCKEN, Heerlen)

Fig. 1, 2. *Bairdia* (*Rectobairdia*) sp. 120.

- 1: specimen SP1a-29, dorsal and lateral views of complete carapace;
- 2: specimen SP1a-32, dorsal and lateral views of complete carapace.

Fig. 3, 4. *Bairdia* (*Bairdia*) sp. 122.

- 3: specimen SP1a-41, dorsal and lateral views of complete carapace;
- 4: specimen SP1a-42, dorsal and lateral views of complete carapace.

Fig. 5. *Bairdiocypris* aff. *rudolphi* (KUMMEROW 1939).

Specimen SP1a-15, dorsal and lateral views of complete carapace.

Fig. 6. *Bairdia* (*Bairdia*) sp. 123.

Specimen SP1a-26, dorsal and lateral views of complete carapace.

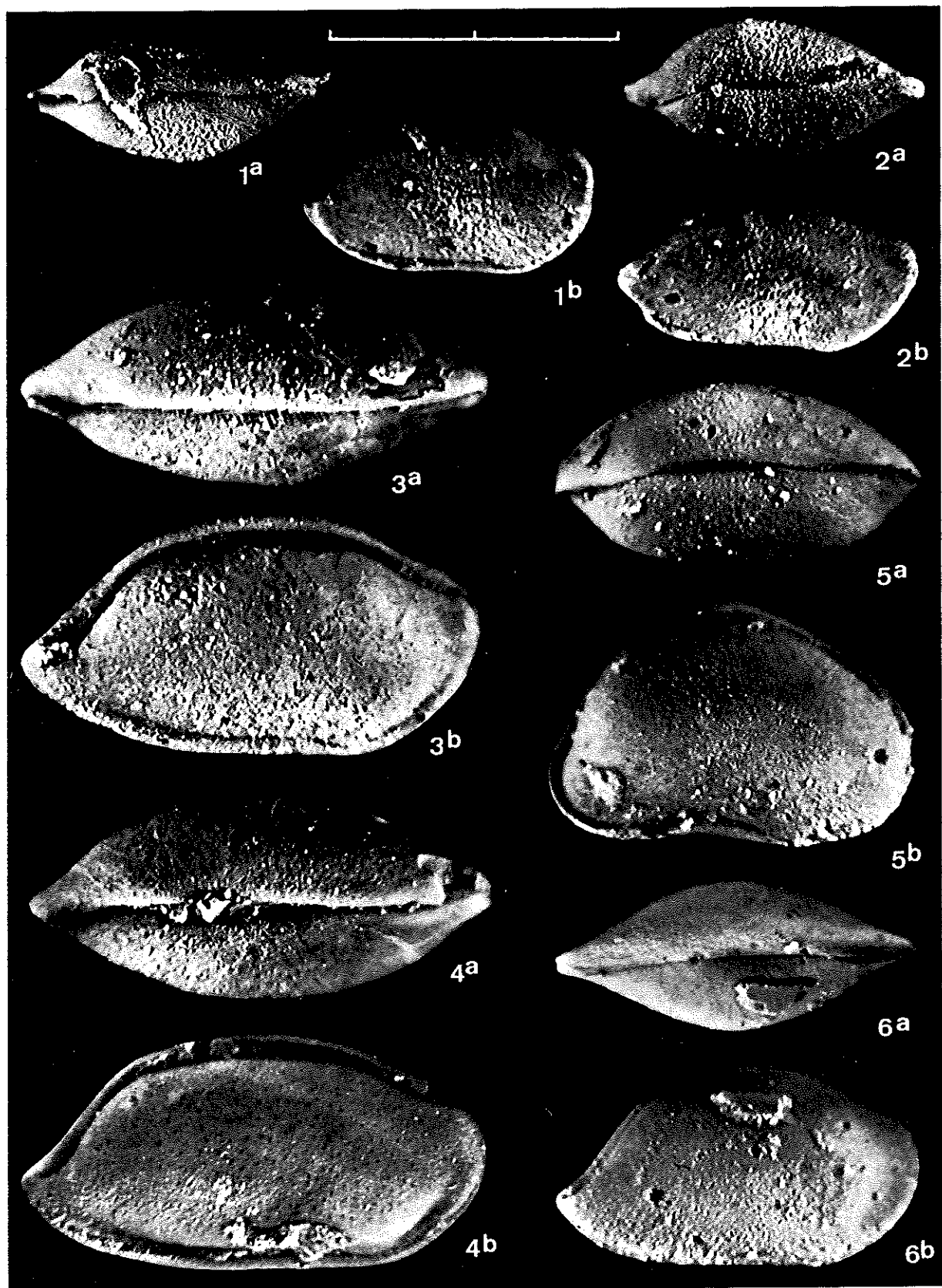


PLATE 10

(scale = 1 mm; photographs M. BEYER, Heerlen)

- Fig. 1. *Hollinella* (*Keslingella*) sp. 53 BECKER & BLESS 1974.
Specimen SP1a-2, lateral view of LV.

- Fig. 2. *Shishaella* aff. *porrecta* (ZANINA 1956) sensu BECKER & BLESS 1974 (species 62).
Specimen SP1a-57, dorsal and lateral views of juvenile carapace.

- Fig. 3. *Uchtovia* sp. 86 (BECKER & BLESS 1974).
Specimen SP1b-14, dorsal and lateral views.
aff. *Uchtovia abundans* (POKORNY 1951), very common in the Middle Devonian of the Rhenish Slate Mountains and Moravia; formerly ascribed by various authors to *Cavellina*.

- Fig. 4. Palaeocopid ? ostracode sp. 124.
Specimen SP1a-55, dorsal, lateral and ventral views of inner mold, showing impression of presumable inner lamella.

- Fig. 5, 6. *Acutiangulata* cf. *acutiangulata* (POZNER in TSCHIGOVA 1960) sensu BUSHMINA 1968 (= part of species 23 BECKER & BLESS 1974).
5: specimen SP1b-19, dorsal and lateral views of complete carapace;
6: specimen SP1b-38, dorsal and lateral views of complete carapace.
Specimen RG31-52, figured by BECKER & BLESS (1974) as *Acratia* aff. *rostrata* ZANINA 1956 is now inserted in this group of more elongated and less inflated ostracodes.

- Fig. 7. Podocopid ostracodes indet.
Specimen SP1a-59, single valve.

- Fig. 8. *Knoxiella* sp. 125.
Specimen SP1a-5, single valve. Differs from other knoxiellid species in ornamentation pattern.

- Fig. 9. Palaeocopid ? ostracode indet.
Specimen SP1a-9, internal mold of single valve.

- Fig. 10. Palaeocopid ? ostracode indet.
Specimen SP1a-52, single valve.

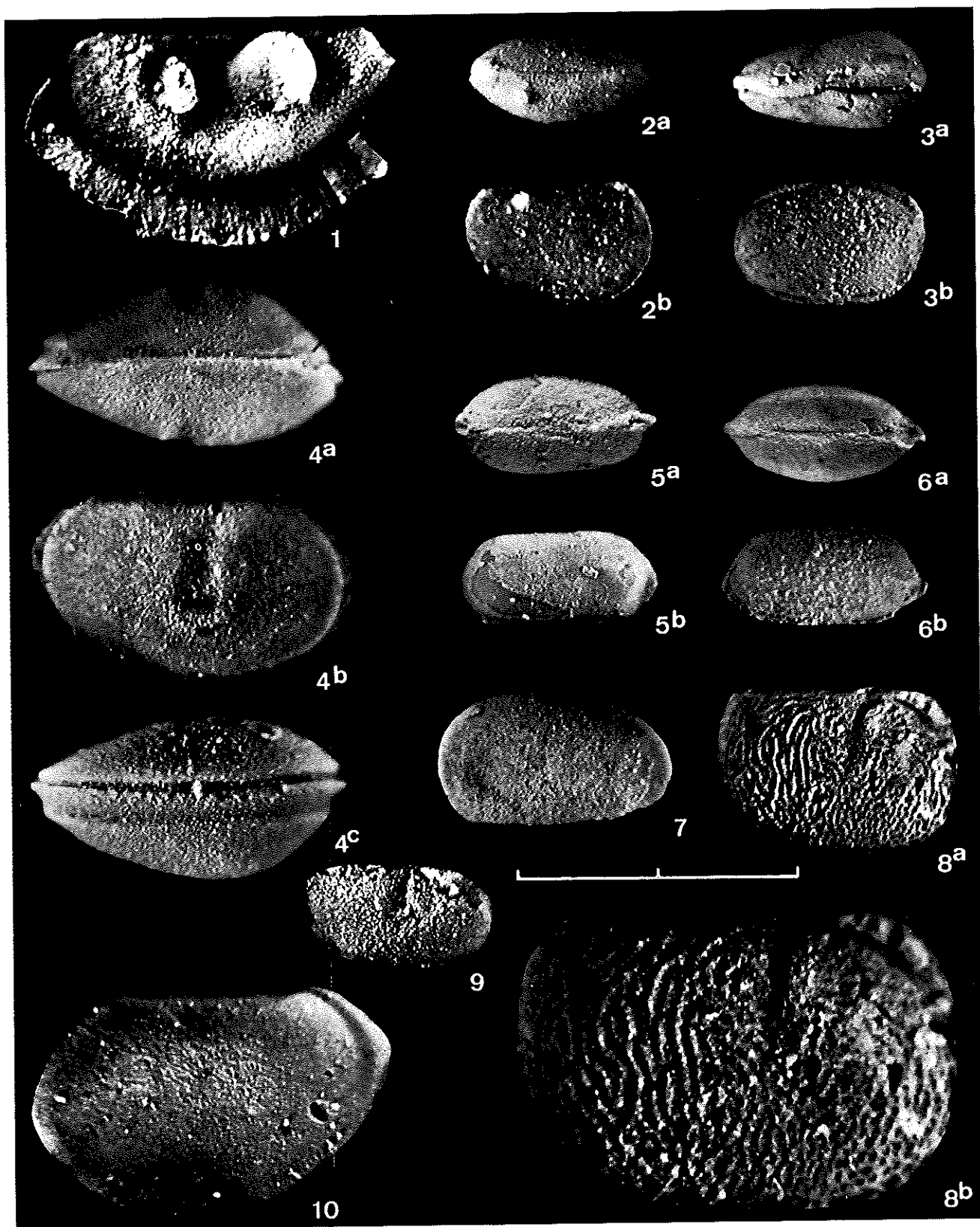


PLATE 11

(scale A = 1 mm; scale B = 1 mm for details; photographs L. R. FUNCKEN, Heerlen)

Fig. 1—3. *Bernix* *venulosa* KUMMEROW 1939 (species 42). Three heteromorphic specimens. Tn1bγ of Chanxhe (Ourthe Valley).

- 1: specimen CH111B, lateral view of complete carapace with slightly dislocated valves, 1 b showing inner lamella of LV;
- 2: specimen CH111G, LV with shell partly removed in order to show muscle scar and venose lines, which do not exist on inflated anteroventral part;
- 3: specimen CH111C, dorsal, lateral and ventral views of complete carapace,
3 d: detail of ornamentation around sulcus.

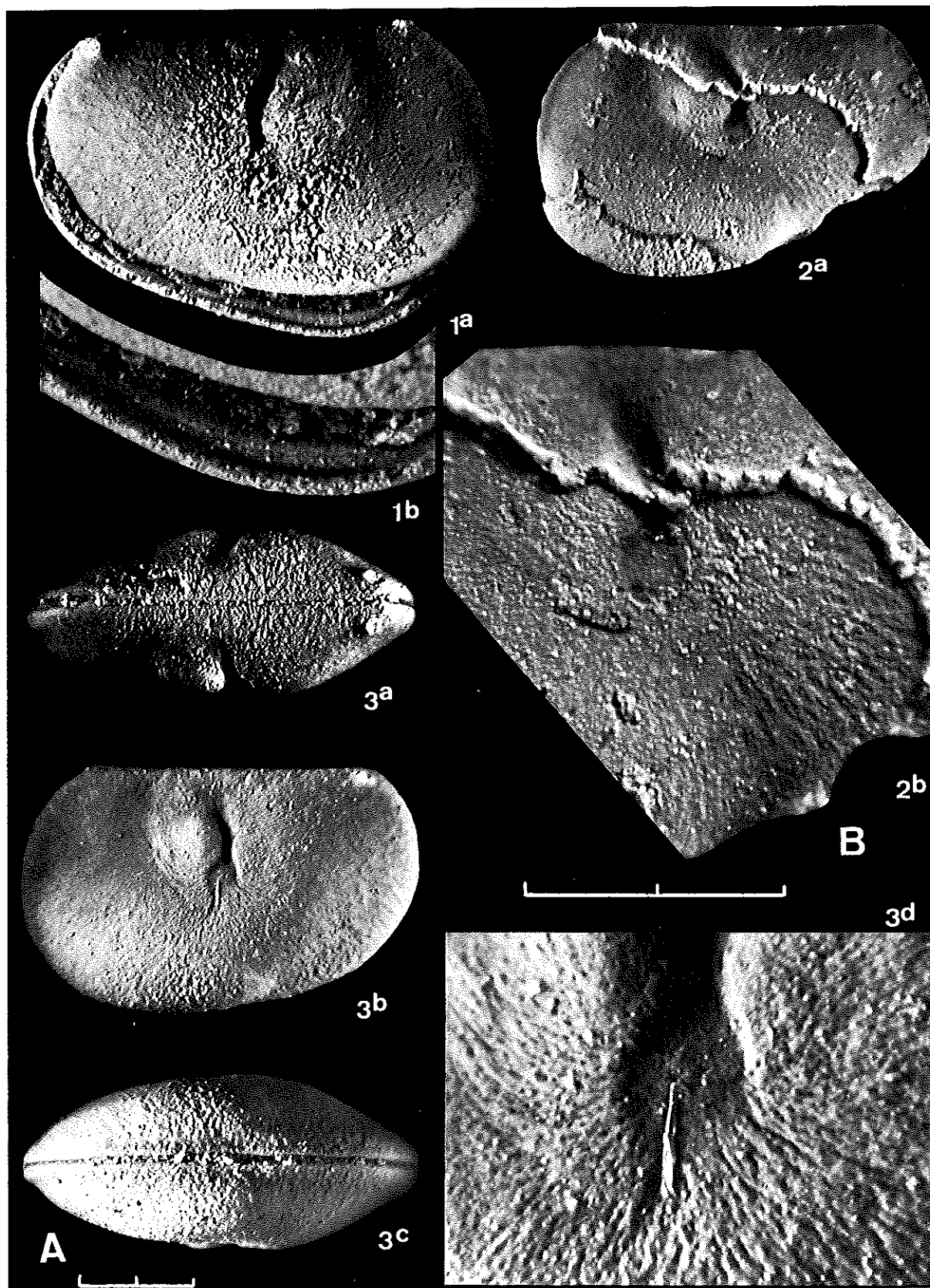


PLATE 12

(scale A = 1 mm for fig. 1a and 2a; scale B = 1 mm for fig. 3—7;
scale C = 1 mm for fig. 8 and 9; photographs L. R. FUNCKEN, Heerlen)

Fig. 1—7. "*Bernix*" *venulosa* KUMMEROW 1939 (species 42).

- 1: thin section through anterior of heteromorphic LV, specimen CH111b;
1 b: detail of contact with inner lamella;
- 2: thin section through anterior of tecnomorphic LV, specimen CH111c;
2 b: detail of grooved hinge;
- 3: specimen CH111D, juvenile LV;
- 4: specimen CH110-16, juvenile LV;
- 5: specimen CH110-17, juvenile LV;
- 6: specimen CH111H, adult LV of tecnomorph;
- 7: specimen AN47a, adult RV of tecnomorph.

Fig. 8. *Aparchites* sp. 126.

Specimen CH110A-55, single valve with remnants of flange. This species differs from *Aparchites* sp. 41 BECKERS & BLESS 1974 in ornamentation and less prominent muscle scar.

Fig. 9. *Kummerowia* aff. *praetexta* (KUMMEROW 1939) (= *Platychilina* aff. *praetexta* KUMMEROW sensu BECKER & BLESS 1974) (species 56).

Specimen CH111Q-9, single valve. The genus name *Platychilina* KUMMEROW 1939 was already preoccupied by *Platychilina* KOKEN 1892. It is curious to notice that, according to LEVINSON & MOORE (in MOORE, ed., 1961, p. Q145), also THORSLAND created an ostracode genus *Platychilina* in 1940, which had to be substituted for the same reasons. The name *Kummerowia* has been proposed in 1950 by SAMOILOVA & SMIRNOVA.

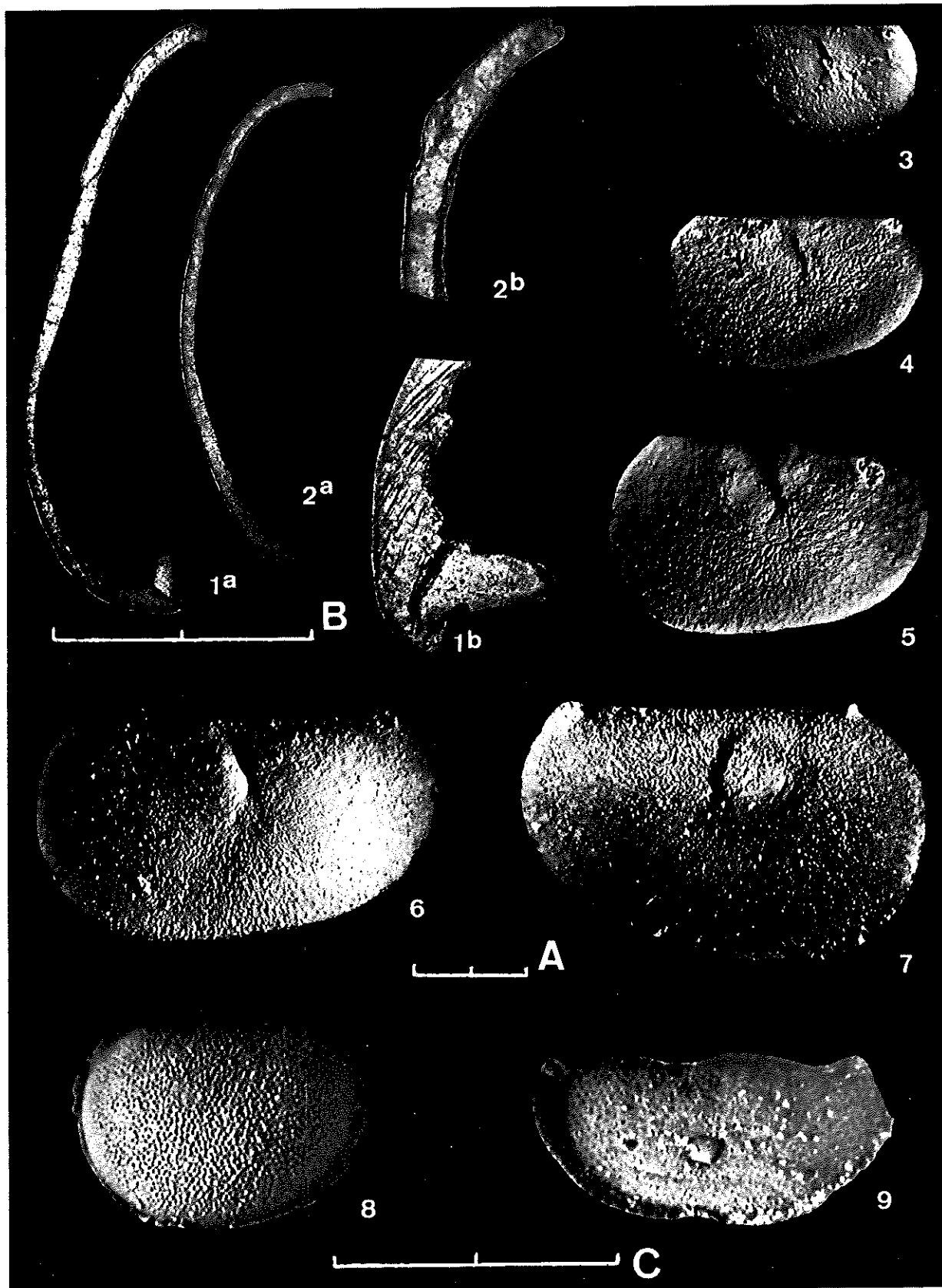


PLATE 13

(scale = 1 mm; photographs L. R. FUNCKEN, Heerlen)

- Fig. 1. *Bairdia* (*Orthobairdia*?) cf. *granireticulata* HARLTON 1929 sensu BUSHMINA 1970 (= *Bairdia* sp. 27 BECKER & BLESS 1974).
Specimen CH111Q-14, dorsal and lateral views of complete specimen. Note smooth spot on place of muscle scar!
- Fig. 2. *Bairdia* (*Rectobairdia*) n. sp. 127.
Specimen CH111P-14, dorsal and lateral views.
Species characterized by ends above midheight. Two specimens have been recognized in the same sample.
- Fig. 3, 4. *Acratia* aff. *rostrata* ZANINA 1956 (= *Acratia* sp. 23 BECKER & BLESS 1974).
3: specimen CH111Q-30, dorsal and lateral views of female ?? carapace;
4: specimen CH111Q-32, dorsal and lateral views of male ?? carapace.
- Fig. 5. *Bairdia* (*Cryptobairdia*) sp. 128.
aff. *B. (C.) singularis* KRÖMMELBEIN 1954 from Refrath Beds (Fr2a) of Paffrath Syncline, Federal Republic of Germany.
Specimen FI42b-40, dorsal and lateral views of complete specimen.
- Fig. 6, 7. *Bairdia* (*Bairdia*) aff. *confragosa* SAMOILOVA & SMIRNOVA 1950.
6: specimen CH111Q-28, single valve;
7: specimen CH111Q-27, single valve.
Species characterized by ornamentation consisting of pustulae and punctae. SAMOILOVA & SMIRNOVA described the species from the Upa and Cherepetz of the Podmoscow Basin, U.S.S.R. BUSHMINA (1970) described the same species from the Upper Tournaisian of the Lena River area, U.S.S.R.
Our species is smaller and shows relatively larger pustulae than the Russian forms.

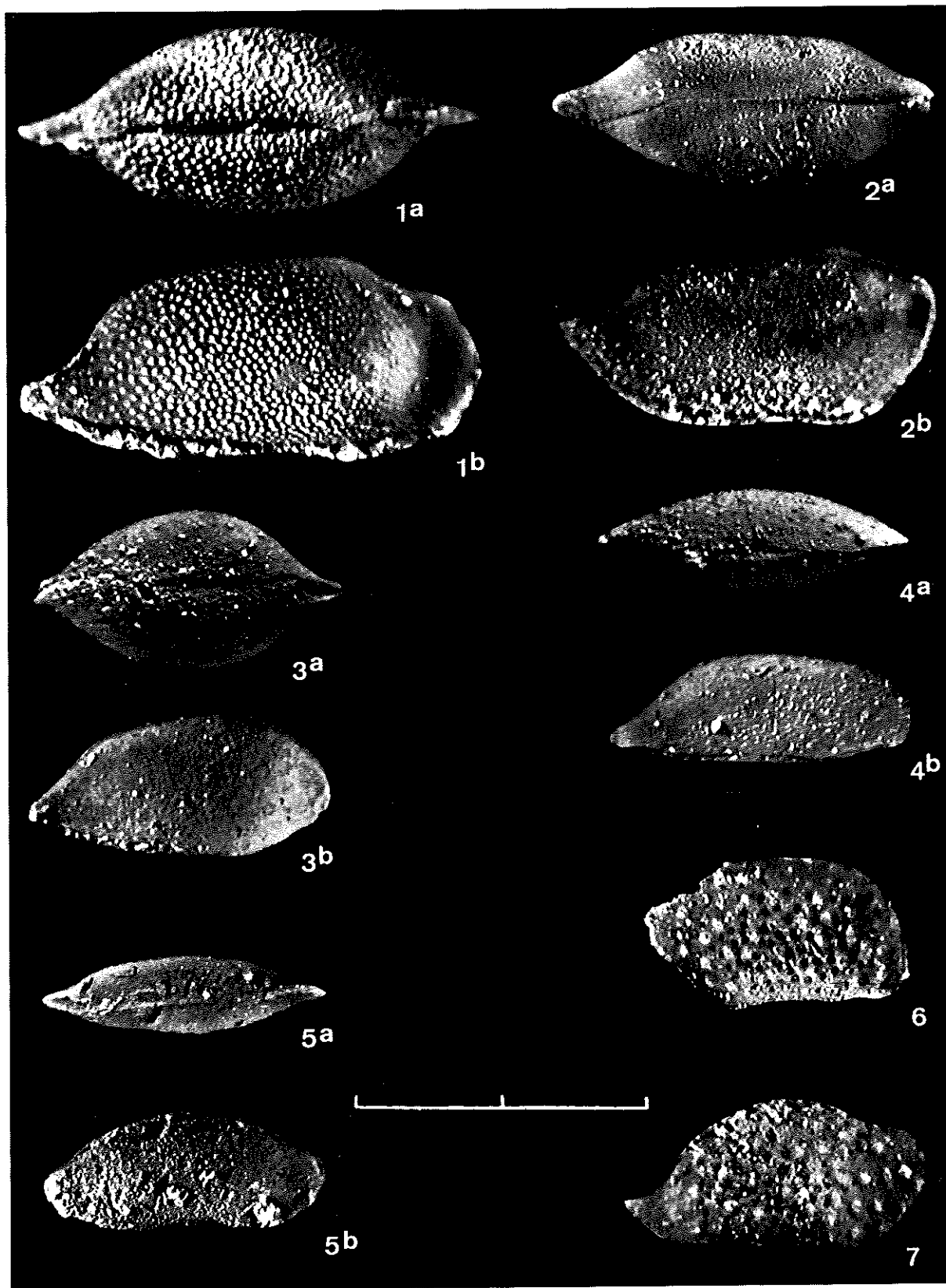


PLATE 14

(scale = 1 mm; photographs L. R. FUNCKEN, Heerlen)

- Fig. 1—5. *Kellettina acutilobata* (ROME 1971).
1: specimen FE4a-21, dorsal, lateral and ventral views of female carapace;
2: specimen FE4a-22, dorsal, lateral and ventral views of female carapace;
3: specimen FE4a-15, dorsal and lateral views of male carapace;
4: specimen FE4a-16, lateral view of juvenile carapace;
5: specimen FE4a-17, lateral and ventral views of male carapace.
- Fig. 6. *Moorites* sp. 97 BECKER & BLESS 1974.
Specimen FE9-49, dorsal and lateral views of complete carapace.
- Fig. 7—9. *Knoxiella* cf. *rugulosa* (KUMMEROW 1939).
7: specimen C455/34-41, dorsal, lateral and ventral views of female carapace;
8: specimen C455/34-52, dorsal and lateral views of juvenile carapace;
9: specimen C455/34-44, RV of male specimen.
- Fig. 10. *Knoxiella* sp. cf. 51 BECKER & BLESS 1974.
Specimen FE4a-29, dorsal and lateral views of complete female carapace.
- Fig. 11. *Knoxiella* cf. *subquadrata* (KUMMEROW 1939).
Specimen FE4a-34, dorsal and lateral views of complete female carapace.
- Fig. 12. *Microcheilinella inversa* ROME 1971.
Specimen FE4a-53, dorsal and lateral views of complete carapace.
- Fig. 13, 14. *Knoxiella* cf. *complanata* (KUMMEROW 1939).
13: specimen C455/34-42, dorsal and lateral views of complete carapace;
14: specimen C455/34-40, single valve.

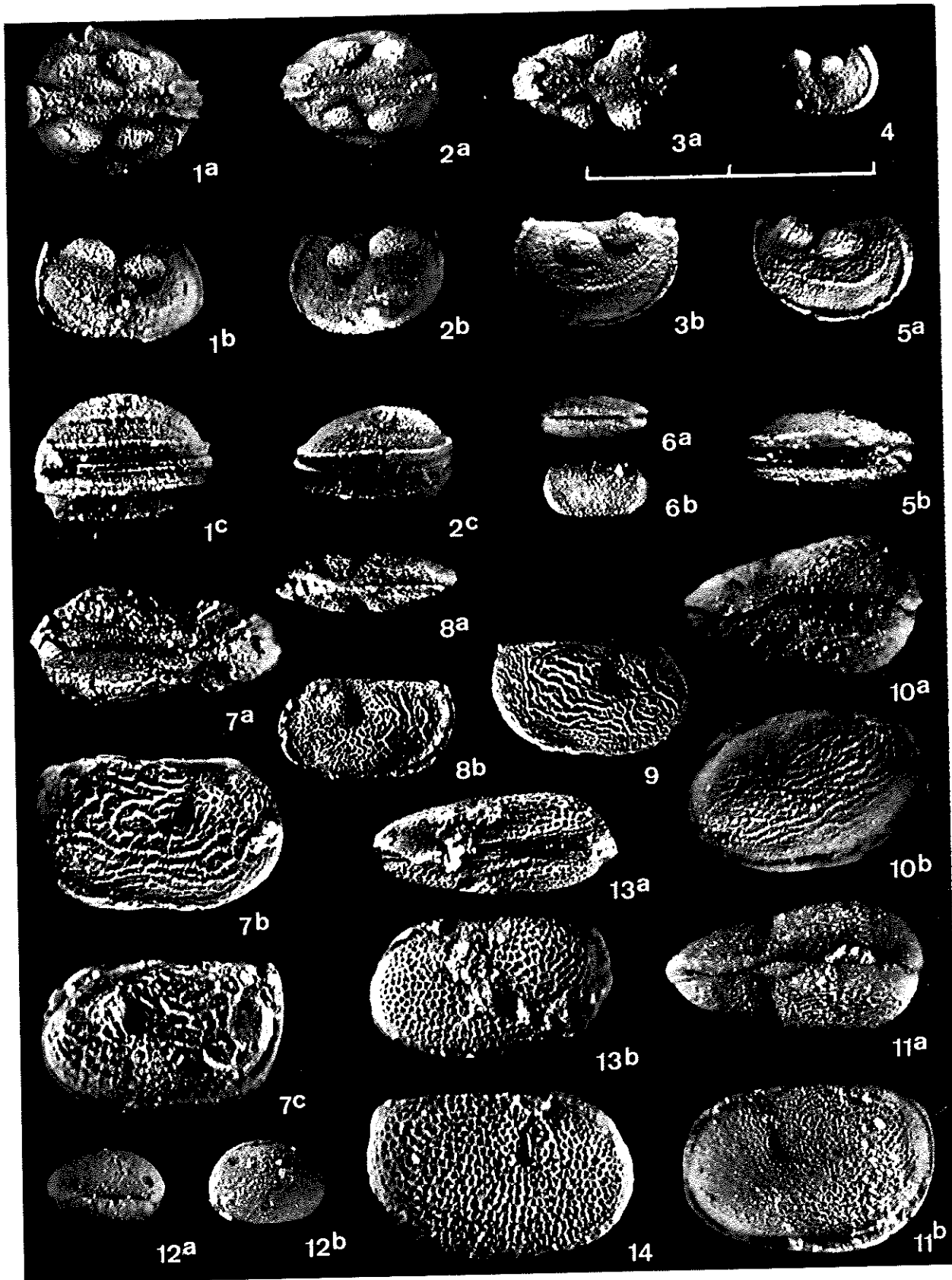


PLATE 15

- Fig. 1, 2. *Calamospora microrugosa* (IBRAHIM) S., W. & B. 1944.
1: 2490/312. Beverire, Fa2c.
2: 2399/454-5. La Gombe, Fa2c.
- Fig. 3. *Leiotriletes pyramidalis* (LUBER) ALLEN 1955.
2369/277. La Gombe, Fa2b.
- Fig. 4-5. *Leiotriletes velatus* (CARO-MONIEZ) comb. nov.
4: 3549/202. Chera, Fa2c.
5: 2372/318. La Gombe, Fa2b.
6: 1147/522. Booischoot borehole, Fa2a ?
- Fig. 7. *Leiotriletes inermis* (WALTZ) ISCHENKO 1952.
3409/163. Chabofosse, Fa2a.
- Fig. 8. *Punctatisporites glaber* (NAUMOVA) PLAYFORD 1952.
2441/480. Beverire, Fa2c.
- Fig. 9, 10. *Retusotriletes planus* DOLBY & NEVES.
Beverire, Fa2c (same specimen).
- Fig. 11, 12. *Retusotriletes* sp. A.
11: 2454/492. Beverire, Fa2c.
12: 2444/176. Beverire, Fa2c.
- Fig. 13-16. *Apiculiretusispora plicata* (ALLEN) STREEL 1957.
13: 2450/706. Beverire, Fa2c.
14-16: Beverire, Fa2c (same specimen).
- Fig. 17-20. *Apiculiretusispora* sp. cf. *Ac. inferus* NAUMOVA 1953.
17: 3894/376. Villers sur Lesse, Fa1a.
18: Detail of 17.
19: 3895/495. Villers sur Lesse, Fa1a.
20: Detail of 19.

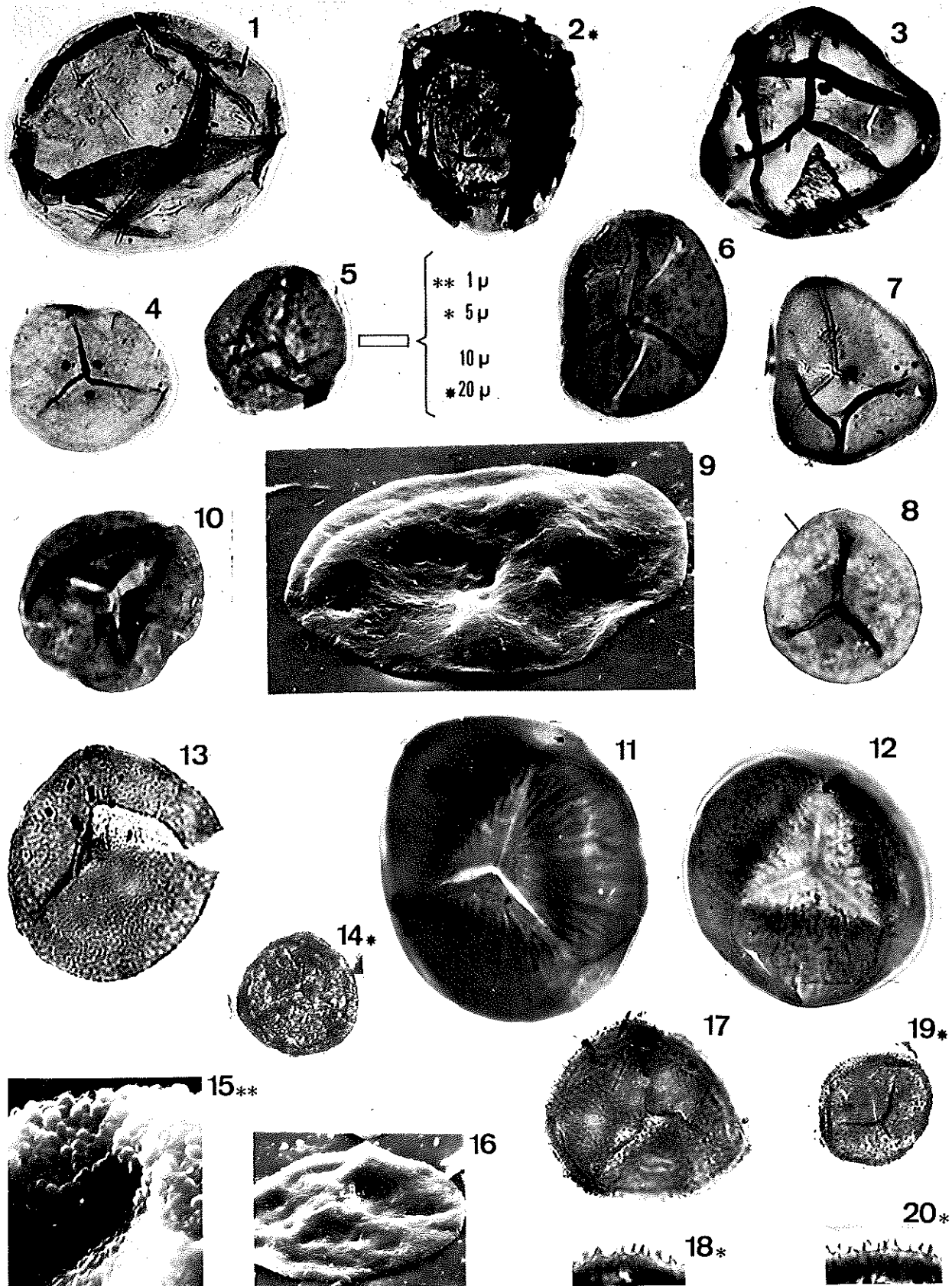
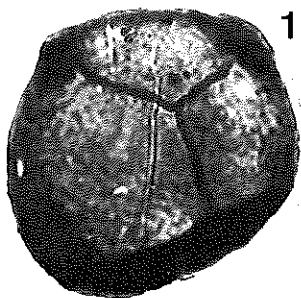
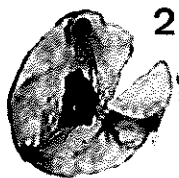


PLATE 16

- Fig. 1. *Pulvinispora depressa* BALME et HASSEL 1962.
3498/667. Rivage-gare, Fa2d.
- Fig. 2, 3. *Pulvinispora* sp. A.
2: 2396/302. La Gombe, Fa2b.
3: 3406/100. Chahofosse, Fa1b.
- Fig. 4. *Aneurospora* (al. *Retusotriteles*) *incohata* (SULLIVAN) comb. nov.
2381/745. La Gombe, Fa2a.
- Fig. 5. *Aneurospora semizonalis* (MCGREGOR) LELE et STREEL 1969.
2399/729. La Gombe, Fa2c.
- Fig. 6—15. *Aneurospora* (al. *Retusotriteles*) *greggsii* (MCGREGOR) comb. nov.
6: 1727/490. Aywaille, Fr.
7: 2431/667. Beverire, Fa2c.
8: Detail of 7.
9: Detail of 7.
10: 1729/407. Aywaille, Fr.
11: Detail of 10.
12—14: Beverire, Fa2c (same specimen).
15: Beverire, Fa2c.
- Fig. 16—19. *Geminospora svalbardiae* (VIGRAN) ALLEN 1965.
16: 3897/485. Villers sur Lesse, Fala.
17: Detail of 16.
18: 2460/534. Beverire, Fa2c.
19: Detail of 18.



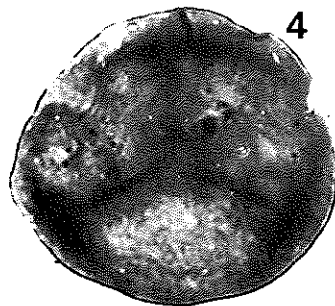
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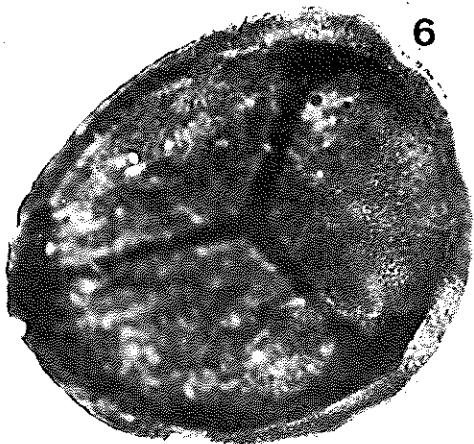
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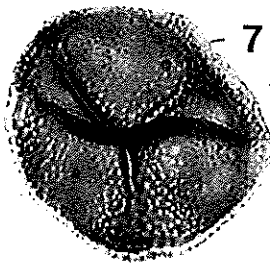
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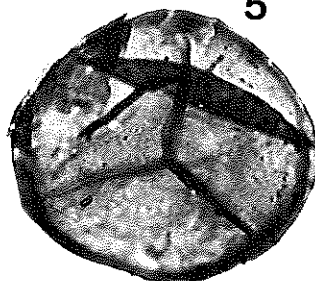
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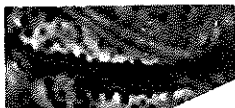
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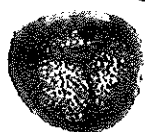
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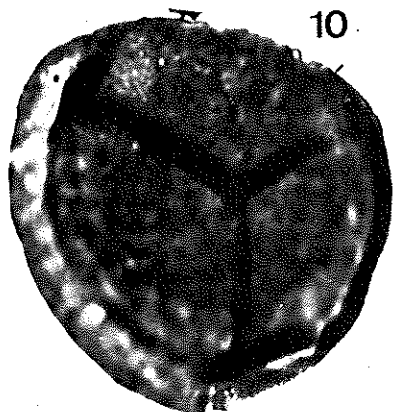
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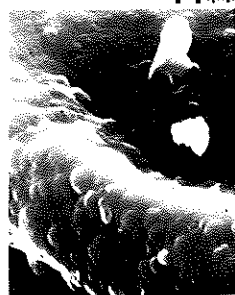
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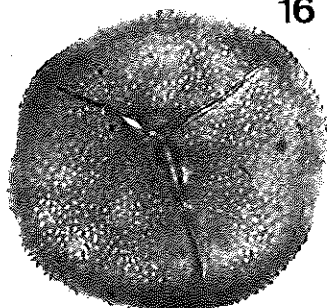
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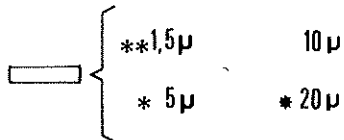
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14**



16

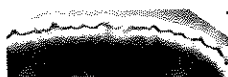


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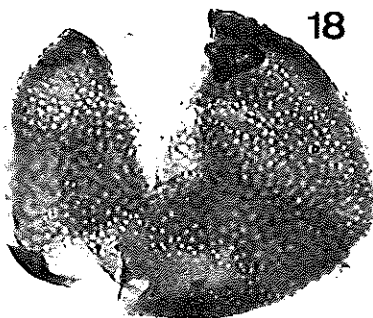
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17*



19*



18

PLATE 17

- Fig. 1, 2. *Dibolisporites echinaceus* (EISENACK) RICHARDSON.
1: 1729/592. Aywaille, Fr.
2: Detail of 1.
- Fig. 3—6. *Dibolisporites* sp. cf. *Lophotriletes atratus* NAUMOVA 1953.
3: 1138/166. Booischoot borehole, Fr.
4: Detail of 3.
5: 3676/342. Booischoot borehole, Fr.
6: Detail of 5.
- Fig. 7. cf. *Anapiculatisporites hystricosus* PLAYFORD 1964.
2736/308. Senzeilles, Fala.
- Fig. 8, 9. *Acanthotriletes hacquebardii* PLAYFORD 1964.
8: 2454/528. Beverire, Fa2c.
9: Detail of 8.
- Fig. 10—12. *Anapiculatisporites* sp. A.
2390/193. La Combe, Fa2b.
10: Proximal surface.
11: Distal surface.
12: Detail of sculpture.
- Fig. 13, 14. *Verrucosiporites grandis* MC GREGOR 1960.
13: 2450/672. Beverire, Fa2c.
14: Detail of 13.
- Fig. 15—17. *Lophozonotriletes lebedianensis* NAUMOVA 1963.
15: 2444/696. Beverire, Fa2c.
16: 2431/247. Beverire, Fa2c.
17: Detail of 16.
- Fig. 18. *Lophozonotriletes* cf. *curvatus* NAUMOVA 1953.
2428/316. Beverire, Fa2c.
- Fig. 19. *Raistrickia variabilis* DOLBY & NEVES 1970.
Wepion borehole: 1741/2/A—Tn1a.
- Fig. 20, 21. *Raistrickia ampullacea* HACQUEBARD 1957.
20: 1766/162. Chanxhe, Tn1a.
21: Detail of 20.
- Fig. 22. *Knoxisporites* cf. *pristinus* SULLIVAN 1968.
2444/775. Beverire, Fa2c.

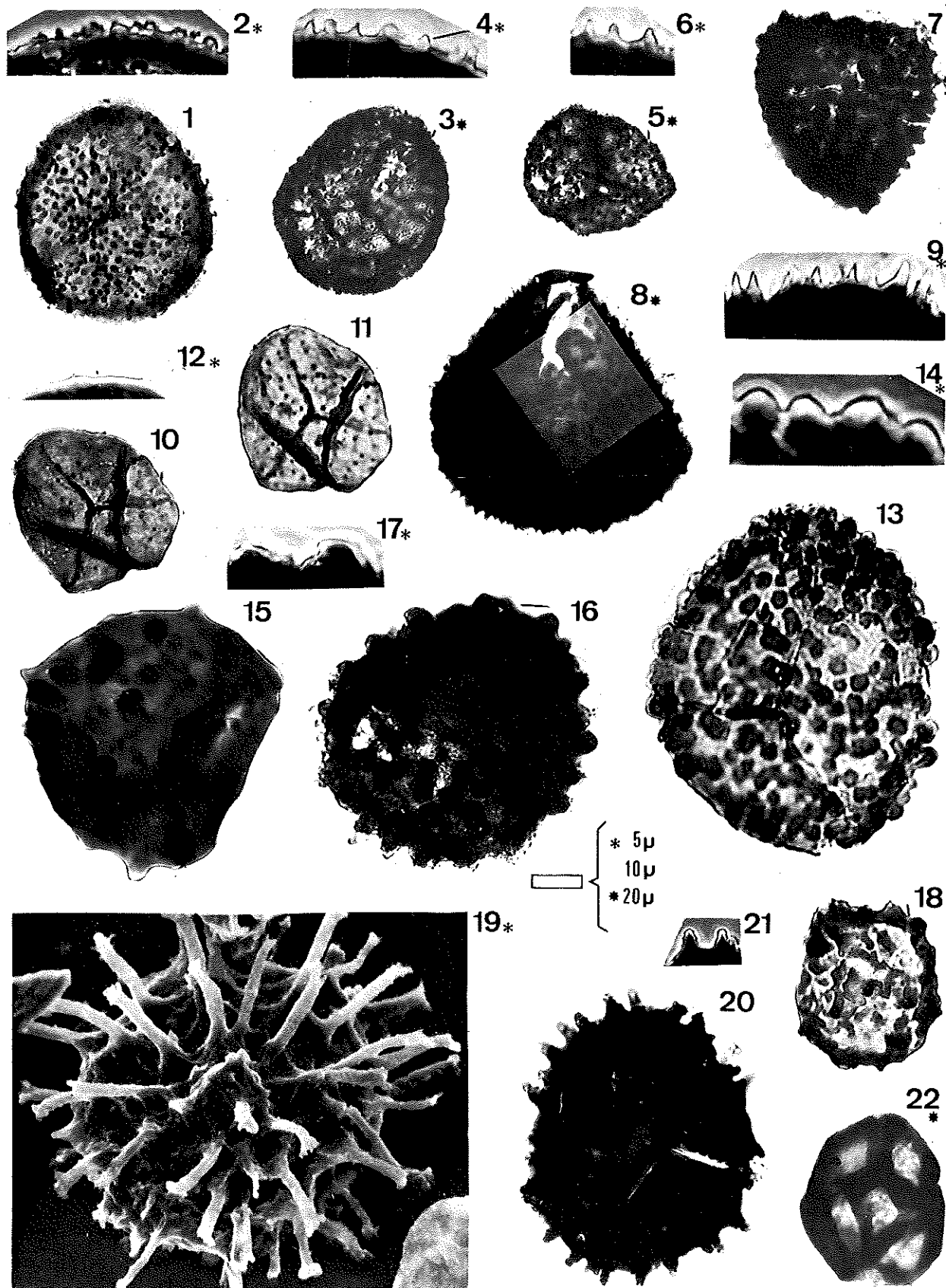


PLATE 18

- Fig. 1. *Cristatisporites echinatus* PLAYFORD 1963.
1619/342. Roysieux, Tula.
- Fig. 2, 3. *Cymbosporites* cf. *cyathus* ALLEN 1965.
2: 1177/663. Booischot borehole, Fr.
3: 1177/535. Booischot borehole, Fr.
- Fig. 4—7. *Samarisporites triangulatus* ALLEN 1965.
4: 3676/195. Booischot borehole, Fr.
5: 1136/418. Booischot borehole, Fr.
6: 1136/709. Detail on another specimen in lateral view.
7: 1136/637. Booischot borehole, Fr.
- Fig. 8. *Samarisporites* sp. cf. *Hymenozonotriletes acanthyrugosus* CHIBRIKOVA 1959.
1147/382. Booischot borehole, Fa2a ?
- Fig. 9—12. *Samarisporites* sp. cf. *Acanthotriletes hirtus* NAUMOVA 1953.
9: 3556/214. Chera, Fa2a ?
10: 3469/498. Villers sur Lesse, Fa1b.
11: Detail of 10.
12: Detail on another specimen.
- Fig. 13—17. *Grandispora* (al. *Hymenozonotriletes*) *microseta* (KEDO) comb. nov.
13, 14: Beverire, Fa2c (same specimen).
15—17: Beverire, Fa2c (same specimen).

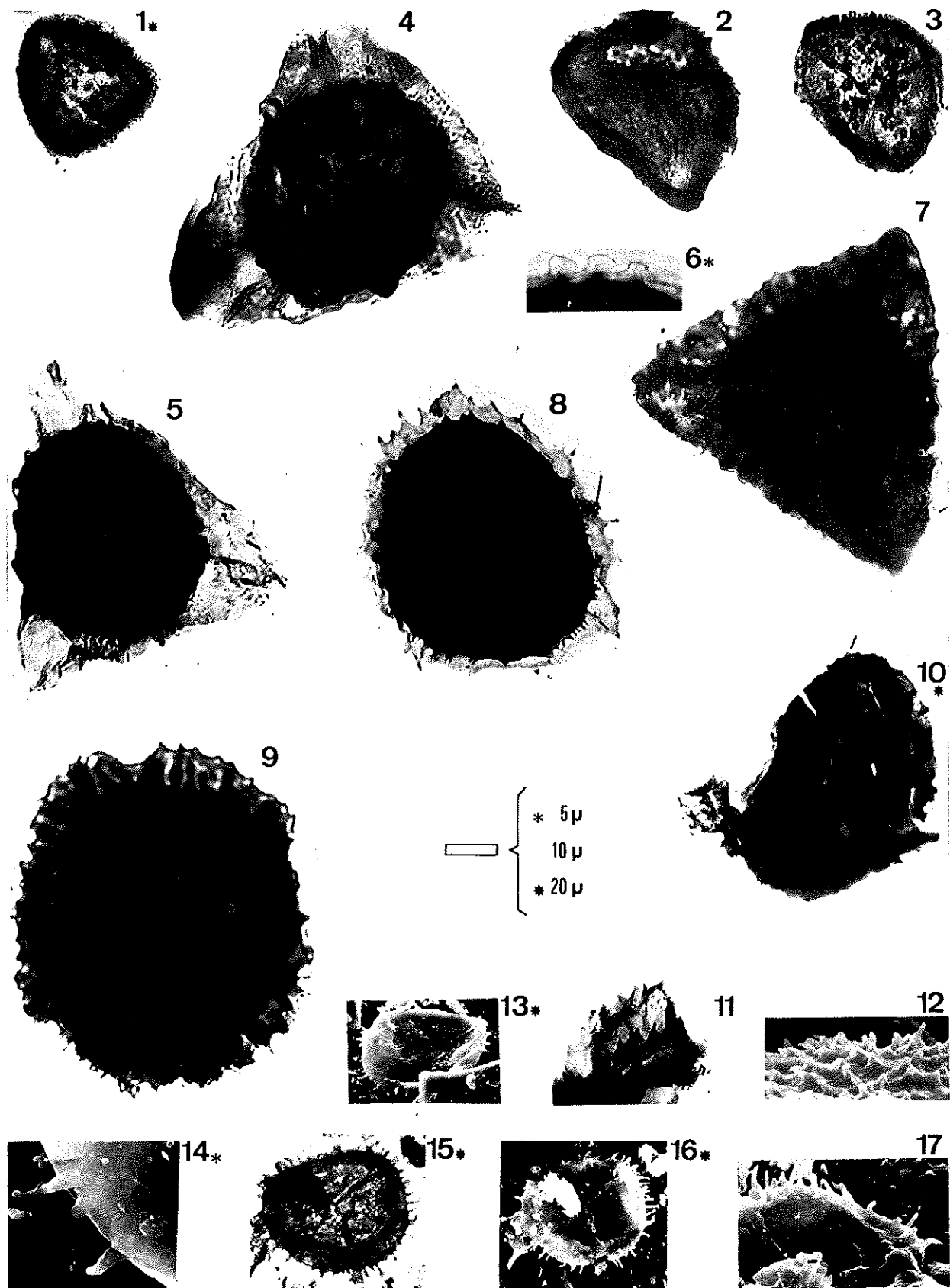
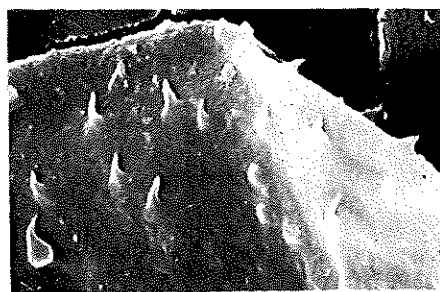
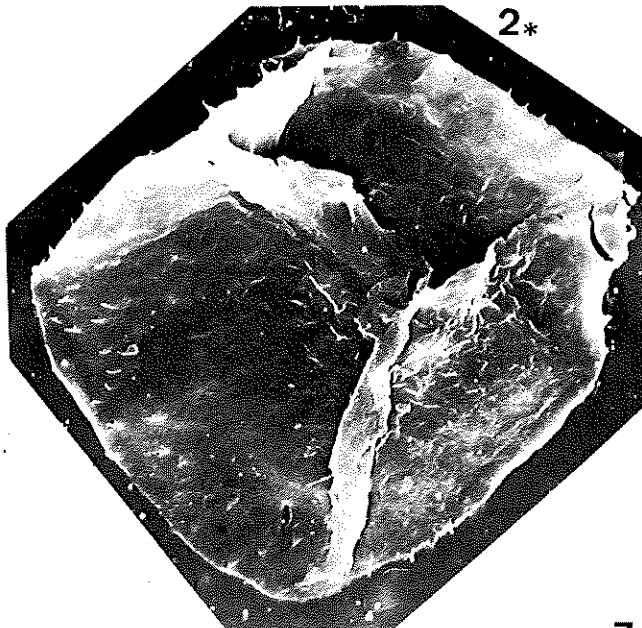


PLATE 19

- Fig. 1—3. *Grandispora* (al. *Archaeozonotriletes*) *gracilis* (KEDO) comb. nov.
La Gombe, Fa2c (same specimen).
- Fig. 4—6. *Grandispora* sp. A.
4: 3549/558. Chera, Fa2c ?
5: 3422/555. Modave, Fa2b.
6: Detail of 5.
- Fig. 7, 8. *Grandispora conspicua* (PLAYF.) PLAYFORD 1971.
7: Wepion borehole 1741/2/B, Tn1a.
8: 2460/049. Beverire, Fa2c.
- Fig. 9—11. *Grandispora* (al. *Archaeozonotriletes*) *jamenensis* (NAUMOVA) comb. nov.
9: 2440/525. Beverire, Fa2c.
10, 11: Beverire, Fa2c (same specimen).
- Fig. 12, 13. *Grandispora* cf. *tenuispina* (HACQ.) PLAYFORD 1971 var. *punctata* var. nov.
12: 2369/529. La Gombe, Fa2b.
13: Detail of 12.



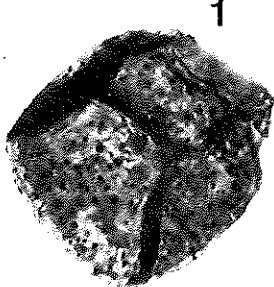
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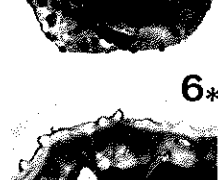
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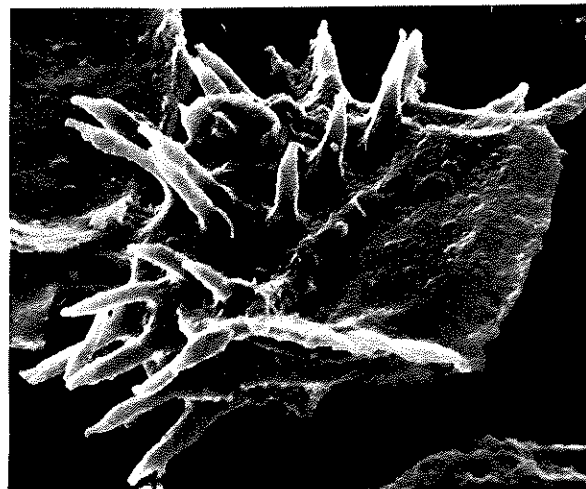
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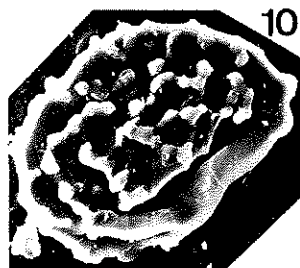


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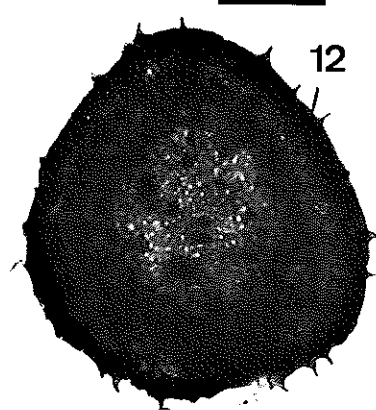
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13*



12

PLATE 20

- Fig. 1. *Spelaeotriletes* (al. *Hymenozonotriletes*) *cassis* (KEDO) comb. nov.
Wepion borehole 1741/1.
- Fig. 2—4. *Spelaeotriletes* (al. *Hymenozonotriletes*) *lepidophytus* (KEDO) comb. nov.
2: 2623/563. Royseux, Fa2d.
3: Detail of 2.
4: Wepion borehole 1741/3/C.
- Fig. 5—7. *Spelaeotriletes* sp. A.
5: 2440/375. Beverire, Fa2c.
6: Detail of specimen fig. 2, plate 25 in PAPROTH & STREEL 1971.
7: Tournai Borehole 316/2/8.
- Fig. 8—14. *Auroraspora* (al. *Hymenozonotriletes*) *poljessica* (KEDO) comb. nov.
8: 2463/557. Beverire, Fa2c.
9: Detail of 8.
10: 3549/087. Chera, Fa2c ?
11: Detail of 10.
12: Wepion borehole, 1741/2/D.
13: 3542/99. Chera, Fa2c ?
14: Detail of 13.
- Fig. 15, 16. ? *Rhabdosporites* cf. *parvulus* RICH. 1965.
15: 2736/227. Senzeilles, Fa1a.
16: Detail of 15.

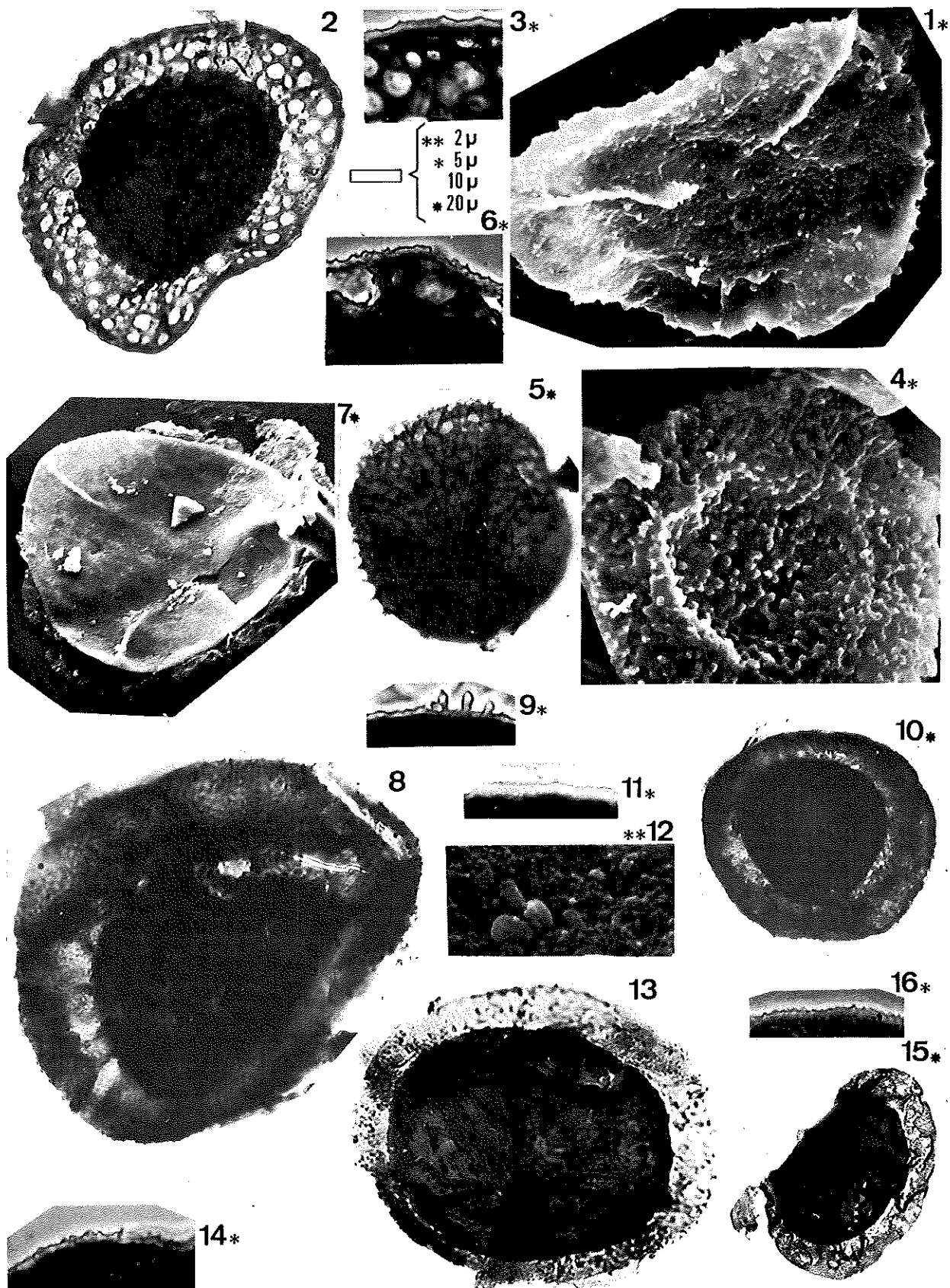


PLATE 21

- Fig. 1. *Auroraspora solisorta* HOFF., ST. & MALL. 1955.
3059/03. Booischot borehole, Fa2a ?
- Fig. 2—5. *Rugospora* (al. *Hymenozonotriletes*) *versabilis* (KEDO 1957) comb. nov.
2: 2444/523. Beverire, Fa2c.
3, 4: Beverire 55/1/4, Fa2c (same specimen).
5: Beverire 55/4, Fa2c.
- Fig. 6, 7. *Auroraspora* sp. cf. *Perotriletes perinatus* HUGHES & PLAYFORD 1961.
6: 3059/05. Booischot borehole, Fa2a ?
7: Detail of 6.
- Fig. 8—11. *Rugospora* (al. *Trachytriletes*) *flexuosa* (JUSCH.) comb. nov.
8, 9: Beverire 55/4/6, Fa2c (same specimen).
10, 11: Beverire 55/4/5, Fa2c (same specimen).
- Fig. 12—14. *Auroraspora* sp. cf. *Diaphanospora perplexa* BALME & HASSELL 1962.
12, 13: Evieux, Fa2c (same specimen).
14: 2466/235. Beverire, Fa2c.

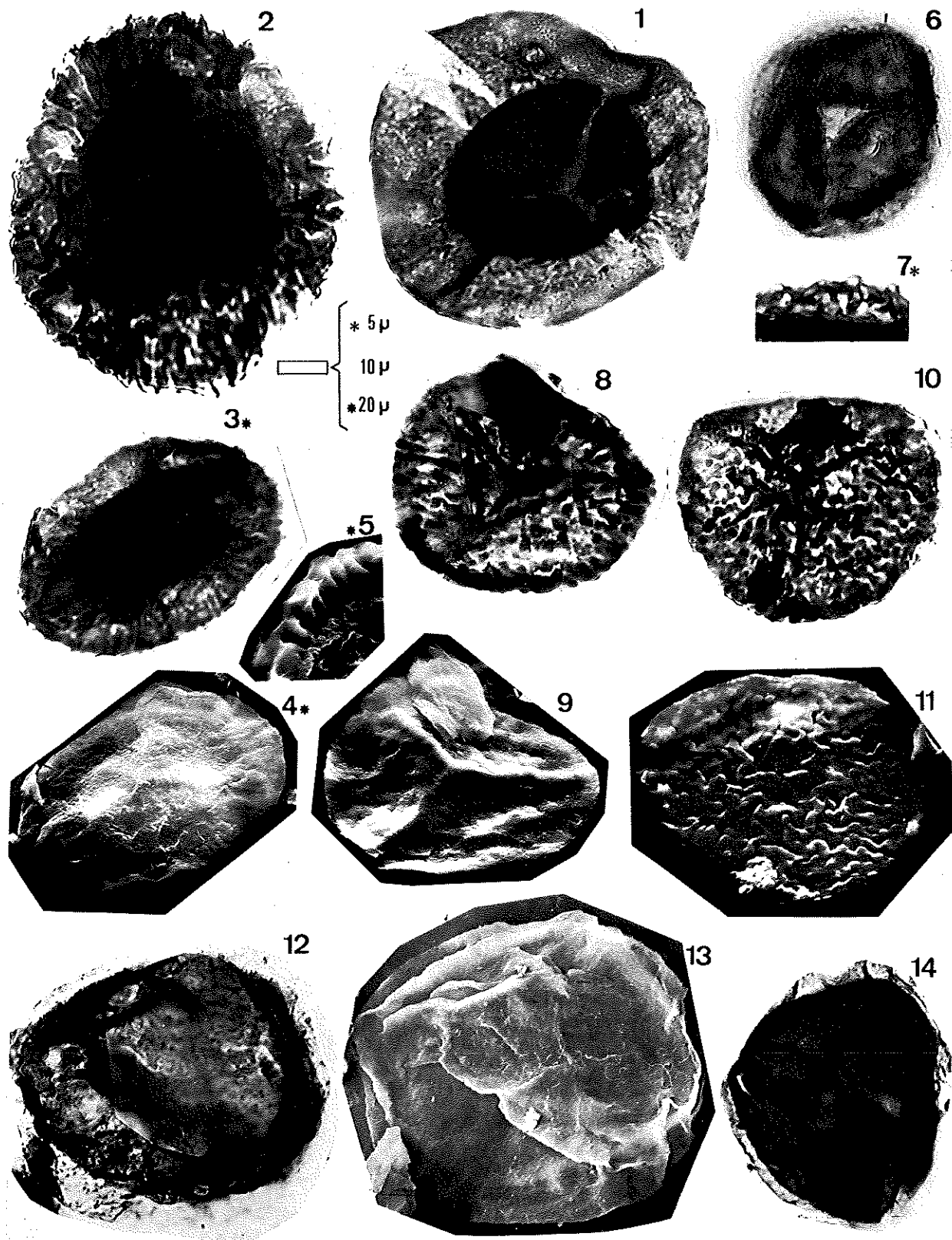


PLATE 22
(Hystricospores)

- Fig. 1, 2. *Hystricosporites multifurcatus* (WINSLOW) MORTIMER & CHALONER 1967.
1: 1147/444. Booischot borehole, Fa2a ?
2: Detail of 1.
- Fig. 3—5. *Hystricosporites* sp. A.
3: 1135/140. Booischot borehole, Gi-Fr. ?
4: 1135/139. Booischot borehole, Gi-Fr. ?
5: Detail of 4.
- Fig. 6—10. *Ancyrospora* sp. A.
6: 1133/264. Booischot borehole, Gi-Fr. ?
7: 1133/665. Booischot borehole, Gi-Fr. ?
8: Detail of 7.
9: 1208/442. Tournai borehole, Fr.
10: Detail of 9.
- Fig. 11—16. *Ancyrospora langii* (TAUGOURDEAU-LANTZ) ALLEN 1965.
11: 2216/635. Comblain-la-Tour, Fa2c.
12: Detail of 11.
13: 2460/456. Beverire, Fa2c.
14: 3057/03. Booischot borehole, Fa2a ?
15: Detail of 14.
16: 1145/776. Booischot borehole, Fa1b-Fa2a ?

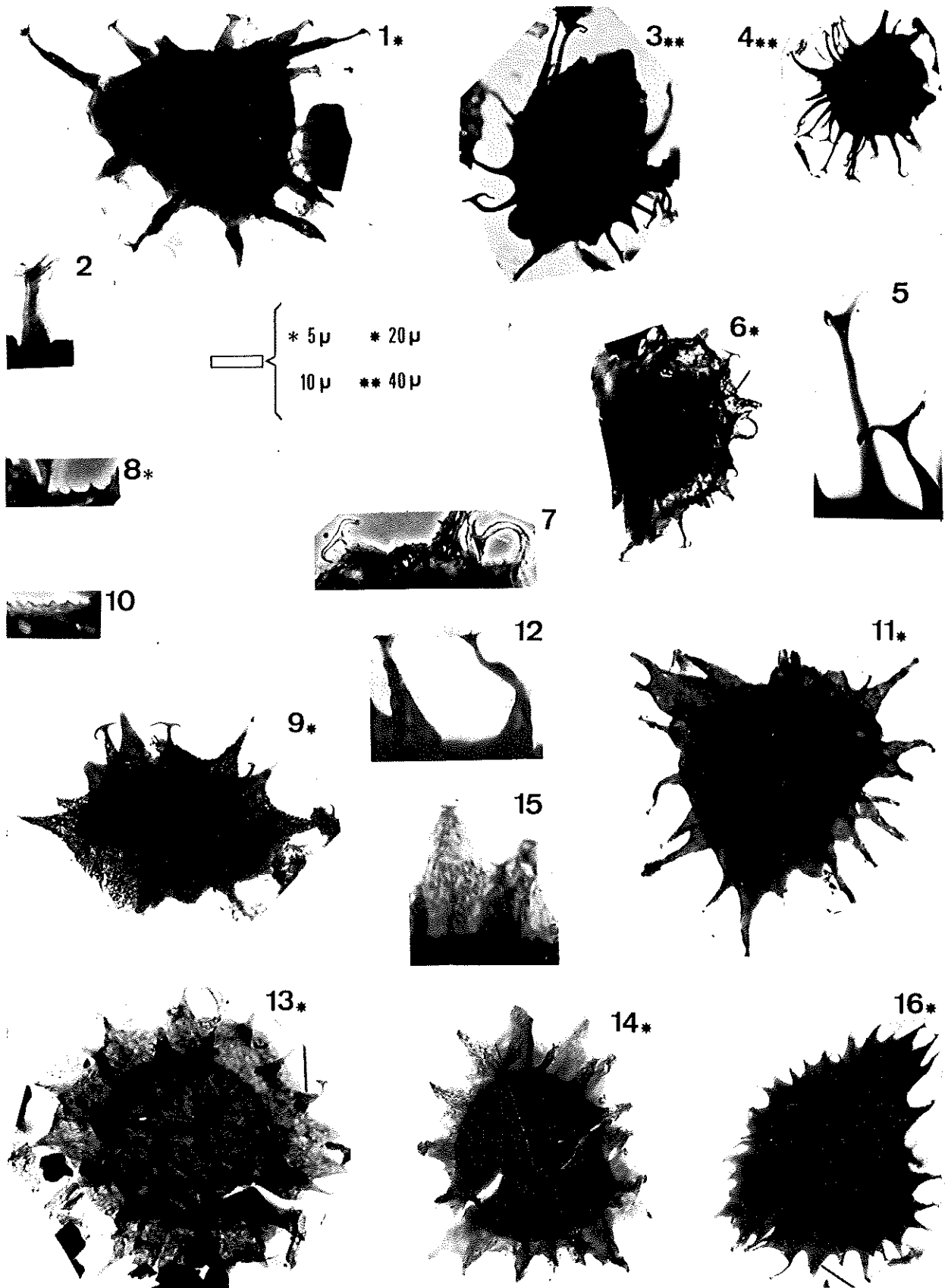
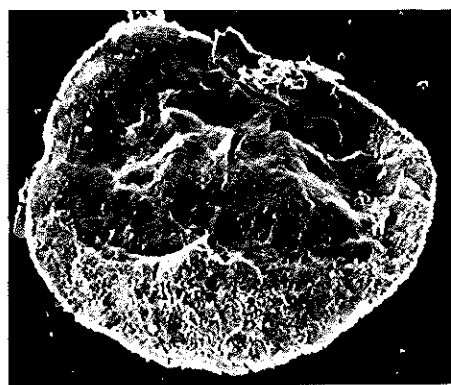
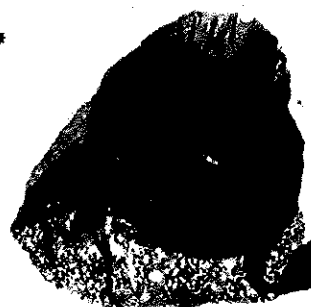


PLATE 23

- Fig. 1, 2. *Trileites* sp. A.
 1: Wepion borehole, 1741/2, Tn1a.
 2: Detail of 1.
- Fig. 3—7. *Lagenicula* sp. A.
 3: 3549/490. Chera, Fa2c ?
 4: 2475/241. Beverire, Fa2c.
 5: Detail of 4.
 6: 2444/552. Beverire. Fa2c.
 7: Detail of 6.
- Fig. 8. *Lagenosporites* (?) *costulatus* TAUGOURDEAU-LANTZ 1960.
 1136/626. Boischot borehole, Fr.
- Fig. 9, 10. Tracheids with grouped pits presumed from *Archaeopteris* (*Callixylon*).
 9: 2428/410. Beverire, Fa2c.
 10: 2466/517. Beverire, Fa2c.
- Fig. 11—17. Plant microfossils from an Ostracode limestone at Spontin (Bocq valley), sample SN1, Tn1a.
 11—13: *Spelaeotriletes lepidophytus*.
 14: Hystriospore.
 15—16: *Raistrickia variabilis*.
 17: Acritarcha.



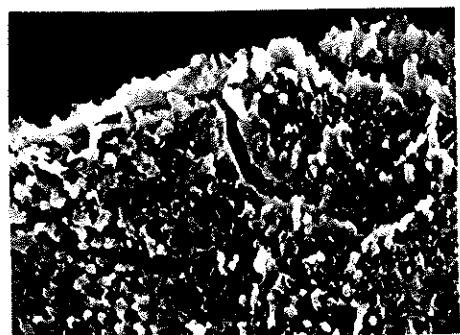
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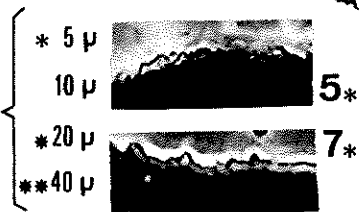
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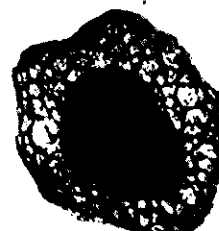


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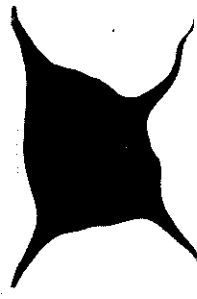


14*

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11*



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16*



PLATE 24

(Acritarcha)

- Fig. 1. *Veryhachium trispinosum* DEUNFF 1954, *sensu lato*,
3556/450. Chera, Fa2a.
- Fig. 2. *Michrystidium* cf. *stellatum* DEFLANDRE emend. SARJEANT 1967.
1143/670. Booischot borehole, Fa1a.
- Fig. 3—5. *Gorgonisphaeridium* sp.
3: 1144/668. Booischot borehole, Fa1.
4: 2390/353. La Gombe, Fa2b.
5: Detail of 4.
- Fig. 6—7. *Gorgonisphaeridium winslowii* ST., JANS. & POC. 1965.
6: Wepion borehole; 1741/1/C-Tn1a.
7: 1895/242. Durnal, Tn1.
- Fig. 8. *Cymatiosphaera* sp.
1144/311. Booischot borehole, Fa1.
- Fig. 9, 10. *Tornacia sarjeanti* ST. & WILL. 1965.
9: 2372/122. La Gombe, Fa2b.
10: 2390/266. La Gombe, Fa2b.
- Fig. 11, 12. *Incertae sedis*.
11: 2781/269. Evieux, Fa2b.
12: 2781/523. Evieux, Fa2b.
- Fig. 13, 14. *Lophosphaeridium* sp.
13: 1147/522. Booischot borehole, Fa1a?
14: Detail of 13.
- Fig. 15. *Protolciosphaeridium* sp.
1427/568. Chanxhe, Fa2c.
- Fig. 16. *Leiosphaeridia* sp.
2490/445. Beverire, Fa2c.

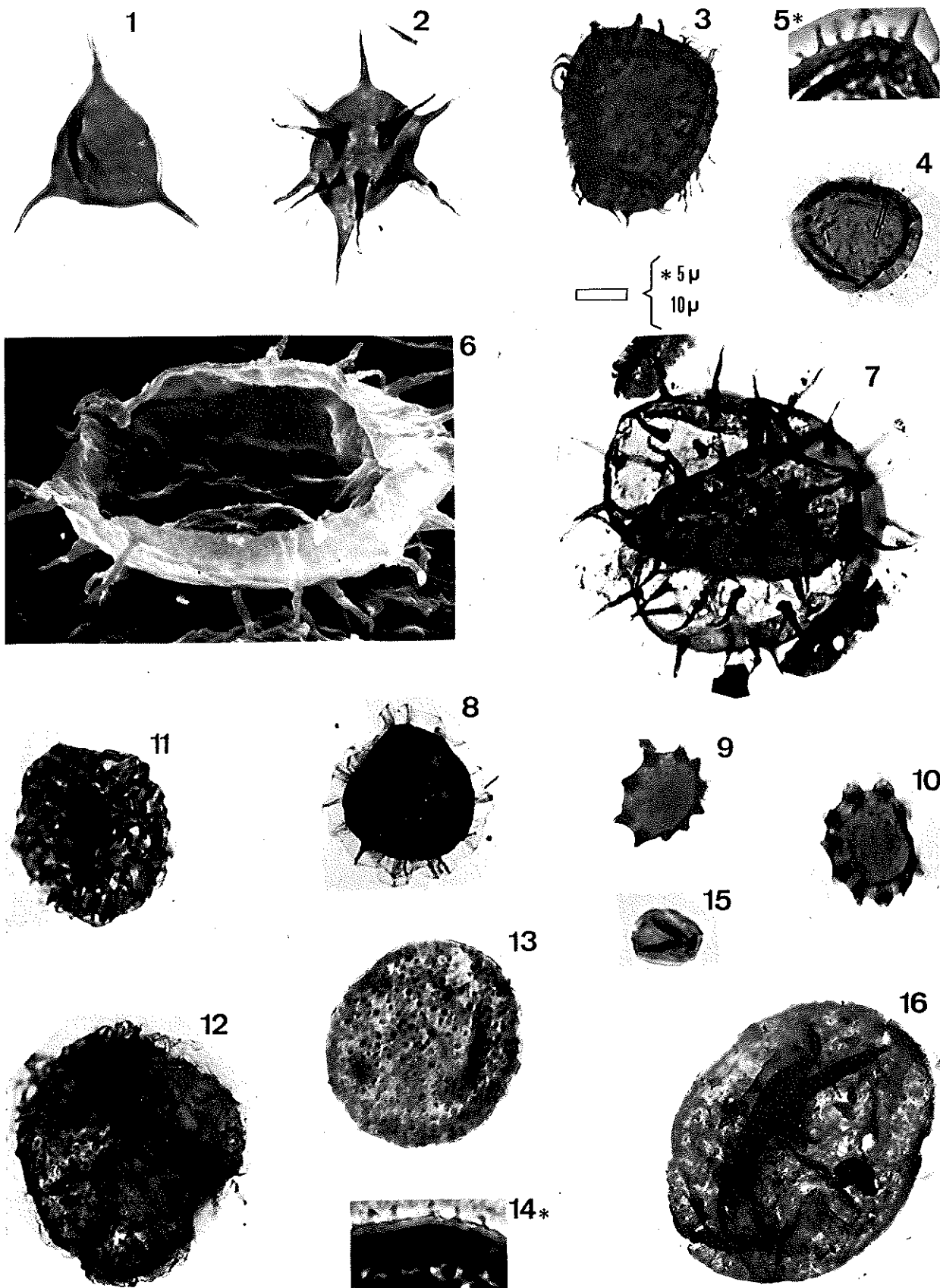


PLATE 25

Fig. 1—6. Dispersed organic matter (Palynofacies) in microscopical slides.

- 1: Small dark organic pieces and microfossils without "organic dust".
Booischoot borehole, Fr.
- 2: Small dark and translucent pieces and microfossils, rich in "organic dust".
La Gombe, Fa2b.
- 3: Small dark and translucent pieces and microfossils, poor in "organic dust".
Beverire, Fa2c.
- 4: Large dark organic pieces and microfossils without "organic dust".
Booischoot borehole, Fr.
- 5: Large dark organic pieces and microfossils with "organic dust".
Beverire, Fa2c.
- 6: Small organic and mineral pieces, with a few microfossils.
Rivage-gare, Fa2b.

Fig. 7—14. Thin slides crossing stratification.

- 7: Micropsammoshale with dark lines of organic pieces in rock corresponding to palynofacies fig. 4. Booischoot borehole, Fr.
- 8: Peloshale corresponding to palynofacies fig. 1. Booischoot borehole, Fr.
- 9: Peloshale. Booischoot borehole, Fa2a ?
- 10: Pelitoshale. Booischoot borehole, Fa2a ?
- 11: idem fig. 7.
- 12: Micropsammoshale. Booischoot borehole, Fr.
- 13: Heterogranular layers. Beverire, Fa2c.
- 14: Micropsammoshale. Booischoot borehole, Fa2a ?

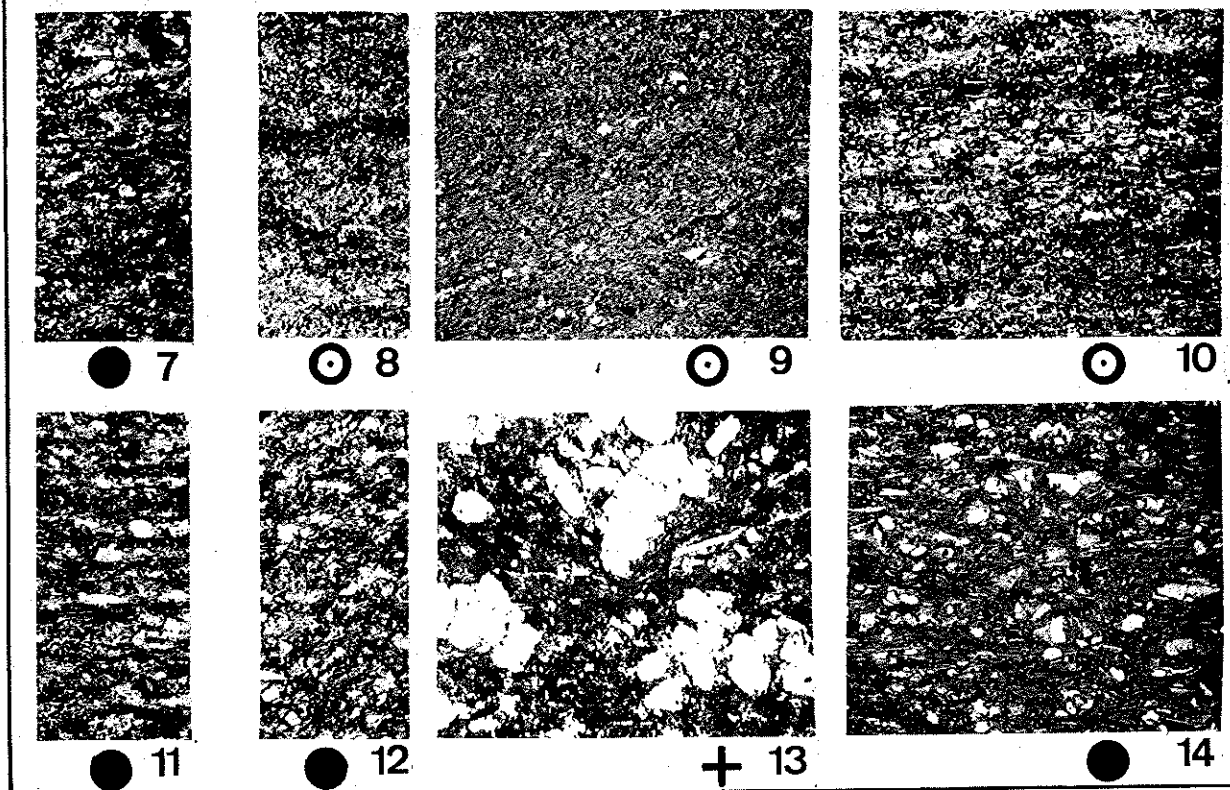
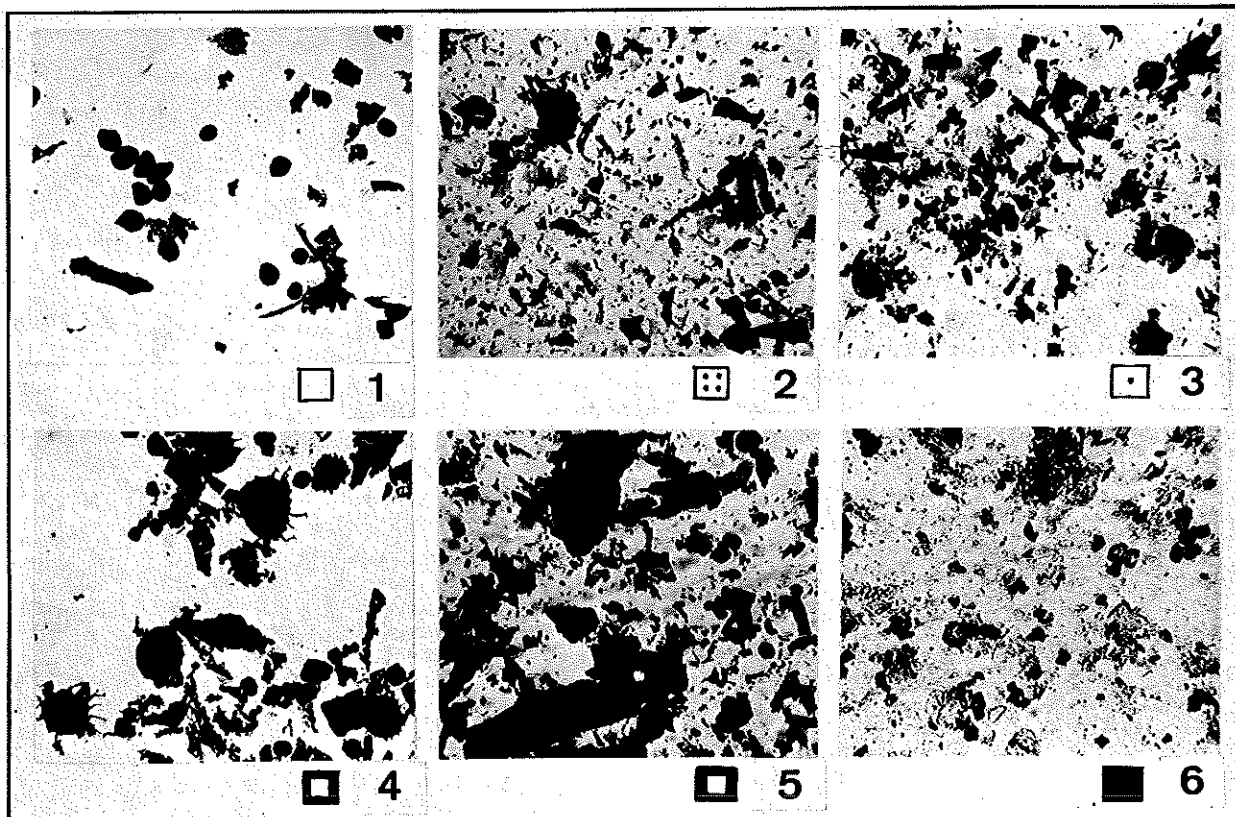


PLATE 26

- Fig. 1. Well sorted psammakose composed of quartz and feldspar grains in complete contact (quartzitic texture). The rock is slightly dolomitic (dolomite content $\pm 7\%$); the dolomite occurs as intergranular (void-filling) cement with typical poecilitic-shaped crystals of rather the same size as the detrital grains. The dolomite is interpreted as being the result of penecontemporaneous and diagenetic void crystallization due to the influx of magnesium-rich water in the back barrier complex.
Montfort Formation, La Gombe Member; back barrier to barrier facies with well sorted sand (without clay) deposition with reverse graded bedding due to hydrodynamic sorting process and subsequent dolomitic hyaline void-filling.
Symbol: Q. La Gombe Quarry. Crossed nicols.
- Fig. 2. Laminated micaceous microarkose with the characteristic double muscovite-biotite flakes parallel to the bedding plane. Locally, these flakes have been more or less intensively contorted by neighbouring detrital grains.
Comblain-la-Tour Formation, Poulseur Member; intertidal to supratidal facies.
Symbol: Q(m). Poulseur section. Plain light.
- Fig. 3, 4. Arkosic psammite with characteristic intergranular clay cement surrounding each detrital quartz and feldspar grain. In contrast to the psammakose of fig. 1, the grains have not been recrystallized because of surrounding clay cement.
Evieux Formation; alluvial-lagoonal facies.
Symbol: Pm. Modave Quarry (Hoyoux valley). Plain light.
- Fig. 5. Micaceous, heterogranular psammite. Mica flakes (muscovite-biotite, the latter more or less intensively oxydized) have been disturbed and reworked by burrowing organisms. Black lenticles are framboidal pyrite concentrations.
Comblain-la-Tour Formation, Poulseur Member; intertidal facies.
Symbol: Pm. Lower part of La Gombe section. Plain light.
- Fig. 6. Contact of dolomitiferous psammakose (upper left part of microphotograph) and pelitoshale (lower right part). The contact is transitional and marked by more micaceous — but still clayey — material. Black spots in the psammakose correspond to pyrite.
Comblain-la-Tour Formation, Rivage Member; intertidal environment.
Symbol: Q-Pé. Rivage Quarry. Plain light.

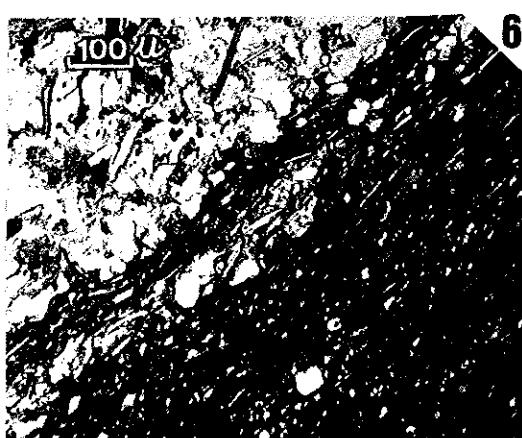
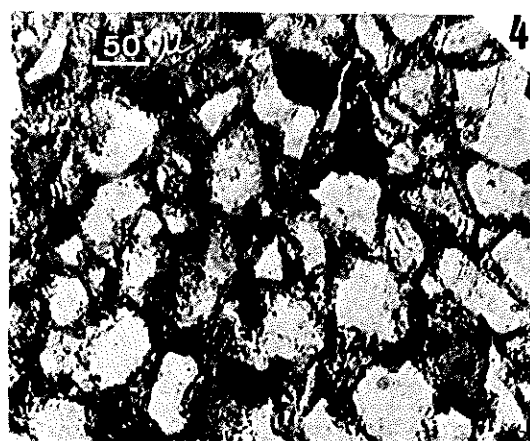
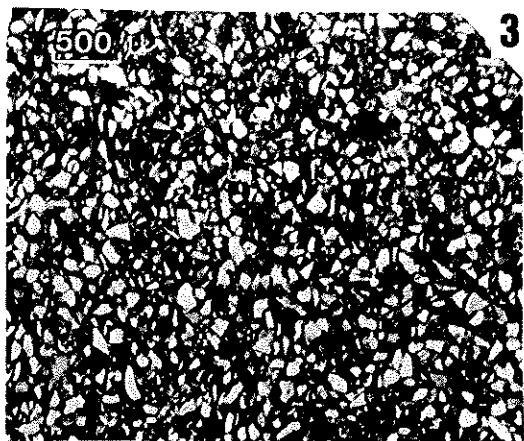
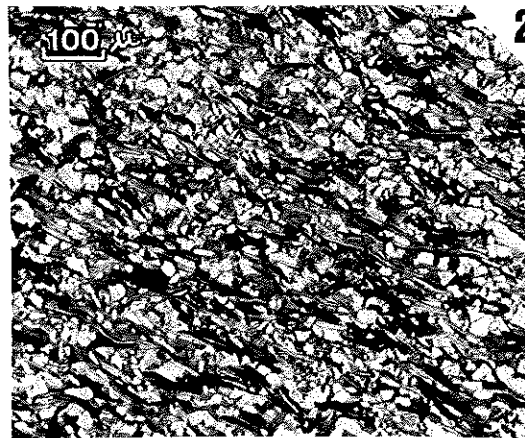
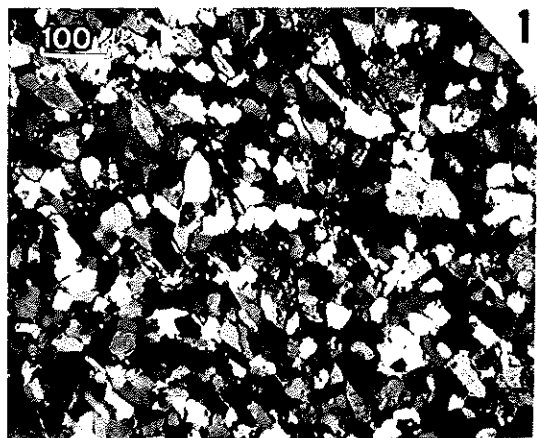


PLATE 27

- Fig. 7. Cryptograined dolomite (dolocryptite) without detrital quartz or feldspar. This kind of sediment corresponds to the direct precipitation of dolomitic mud on the basin floor. Montfort Formation, Barse Member; lagoonal evaporitic facies.
Symbol: Dy. Evieux Quarry. Crossed nicols.
- Fig. 8. Partially recrystallized dolocryptite with some detrital grains, which may have been incorporated in the sediment by a low-energy back-barrier tidal current or blown in by an eolian process in the lagoonal environment.
Montfort Formation, Barse Member; lagoonal facies.
Symbol: Dy(Pm). Chabofosse (Hoyoux valley). Crossed nicols.
- Fig. 9. Arenaceous (arkosic) dolocryptite with rare mica flakes. Sand grains are poorly sorted and irregularly embedded in the dolomitic sediment.
Evieux Formation, Fontin Member; Alluvio-lagoonal facies. This kind of dolomitic deposition typically develops as interstratification of clays in a fining-up alluvial sequence.
Symbol: D(Q). Evieux Quarry. Plain light.
- Fig. 10. Argillaceous and micaceous dolocryptite. The matrix consists of cryptograined dolomite completely mixed with clay and very small mica flakes. The latter are preferentially oriented parallel to the bedding plane. Diagenetic partial recrystallization produces microsparitic dolomite of hyaline appearance in sharp contrast with the darker dusty original dolomite.
Montfort Formation, Barse Member; lagoonal to tidal lagoonal facies. This type of micaceous dolomite deposition occurs when transported dolomite mud and clay-mica material (introduced into the lagoonal complex by tidal or low-energy supratidal currents) are mixed.
Symbol: Ds (s = straticulated). Evieux Quarry. Crossed nicols.
- Fig. 11. Saccharoidal (sparitic) dolomite (dolosparite). One of the rare cases of a practically completely recrystallized cryptitic dolomite, which have been recognized during this study. The diagenesis has produced an intricate fabric of poecilitic to subrhomboidal pure hyaline domolite.
Montfort Formation, Barse Member; lagoonal to tidal lagoonal facies. Higher up in the same bed another exception has been found in the form of completely oxydized, well rounded intraclasts of crinoid articles embedded in reddish clay.
Symbol: Drec. Chabofosse Quarry (Hoyoux valley). Crossed nicols.
- Fig. 12. Dolomitiferous psammakose. Detrital grains are relatively well sorted (without clay) by current and wave activities. Intergranular percolation of magnesium rich lagoonal water has produced "in situ" precipitation of dolomite crystals in small (sub)rhomboidal grains in the original intergranular voids. They outline some detrital grain edges.
Montfort Formation, La Gombe Member; back barrier complex.
Symbol: Q(D). La Gombe Quarry. Plain light.

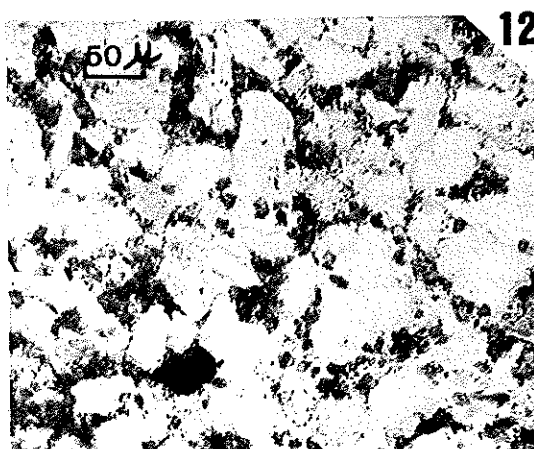
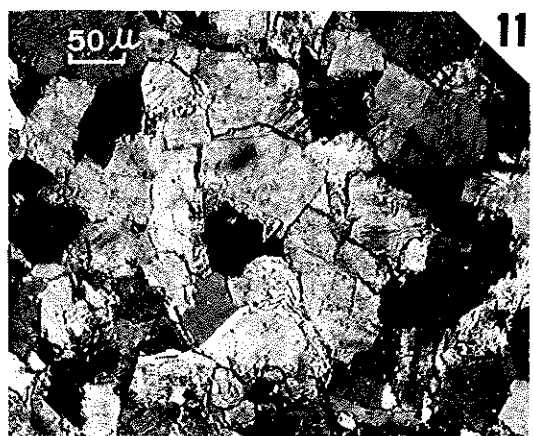
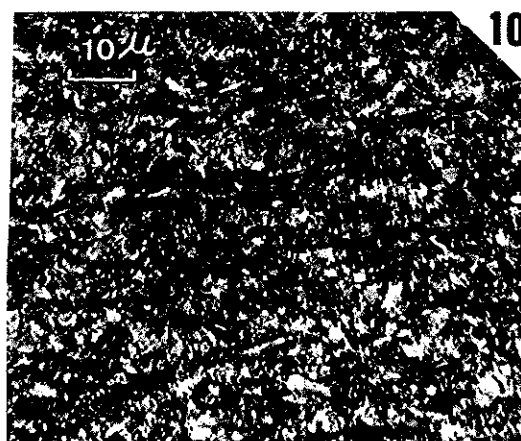
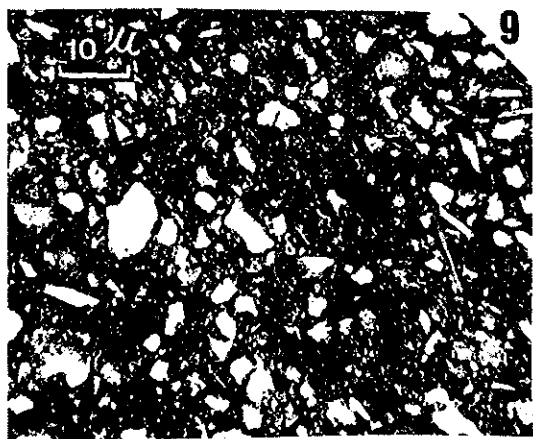
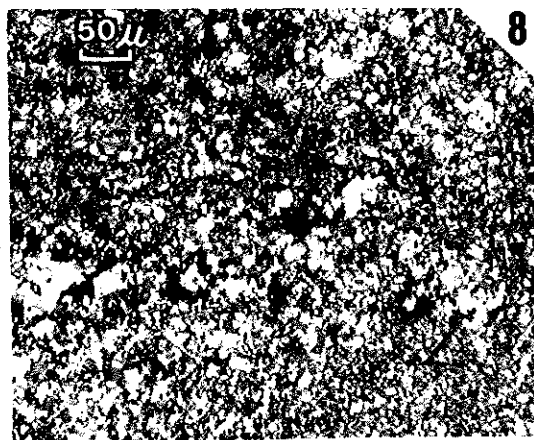
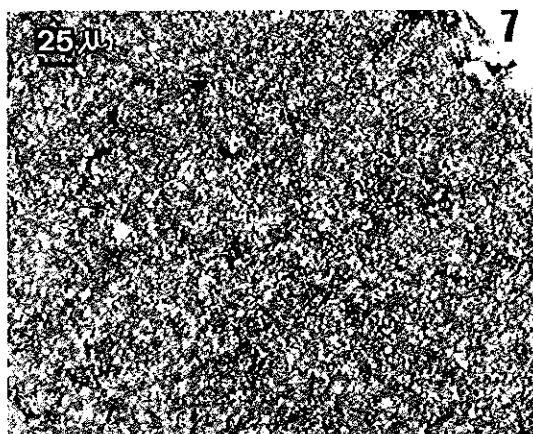


PLATE 28

- Fig. 13. Cryptite (FOLK's micrite) with scattered thin-shelled ostracodes and some silt-size detrital grains. The scarcity of organic debris in the deposit indicates a restricted biofacies.
Montfort Formation, Bon-Mariage Member; occasionally preserved supratidal deposit in a major intertidal to subtidal environment.
Symbol: Cy. Bon-Mariage Quarry. Plain light.
- Fig. 14. Argillaceous cryptite with numerous bivalved thin-shelled or desarticulated ostracodes. Minor admixture of silt-size detrital grains.
Montfort Formation, Bon-Mariage Member; supratidal end member of a rare, completely preserved tidal flat sequence with — from base to top —: subtidal and channel — intertidal — supratidal facies.
Symbol: Cy(pn). Bon-Mariage Quarry (bed 13). Crossed nicols.
- Fig. 15. Arenaceous to argillaceous fossiliferous cryptite with numerous ostracode shells. Evieux Formation; alluvial to tidal restricted marine facies. The deposit occurs at the top of a sequence generated by and in a tidal system (megaripples, ripple drift, microcross laminations).
Symbol: Cy(Pm)-Q). Evieux Quarry ("Carrière de la grotte"). Crossed nicols and Alizarine Red S dyed.
- Fig. 16. Dismicrite to pelmicrite with numerous thin-shelled ostracodes. If fauna displays monogeneric trend of ostracodes, some micropellet concentrations occur, which are probably of coprolithic origin (dwarfed gastropods).
Evieux Formation; supratidal facies. Diagenetic recrystallisation produces some dismicrite.
Symbol: Cy. Evieux Quarry ("Carrière de la grotte"). Crossed nicols.
- Fig. 17, 18. Two fabrics of embedded dwarfed gastropods. In the first microphotograph (fig. 17) the fossil is embedded in a cryptite with accessory silt-size detrital grains. A diagenetic calcite veinlet crosscuts the sediment.
In fig. 18, the cryptite contains numerous well preserved thin-shelled ostracodes.
Evieux Formation; supratidal facies.
Symbol: Cy. Evieux Quarry ("Carrière de la grotte"). Plain light and Alizarine Red S dyed (fig. 17); crossed nicols (fig. 18).

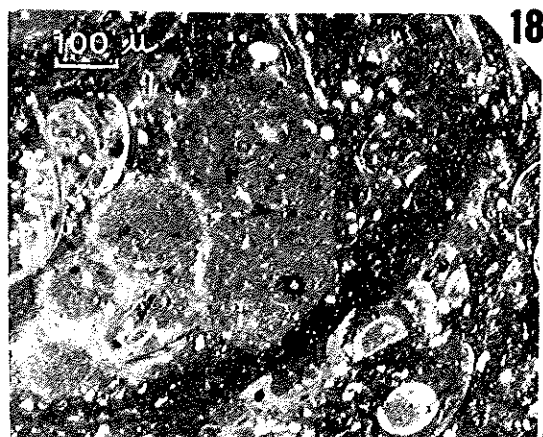
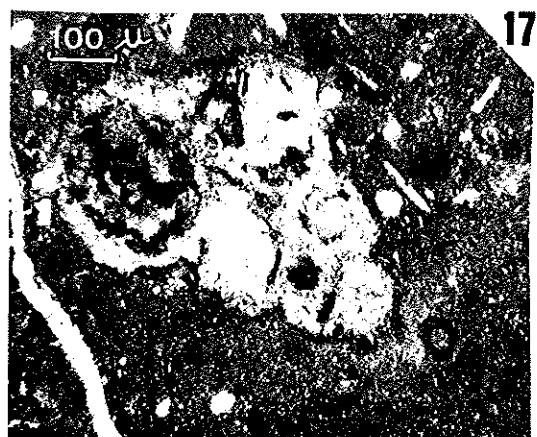
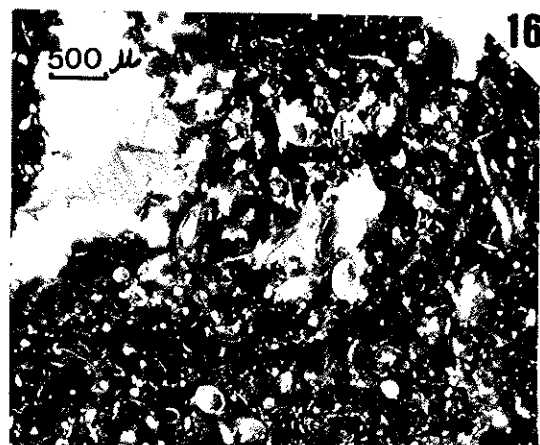
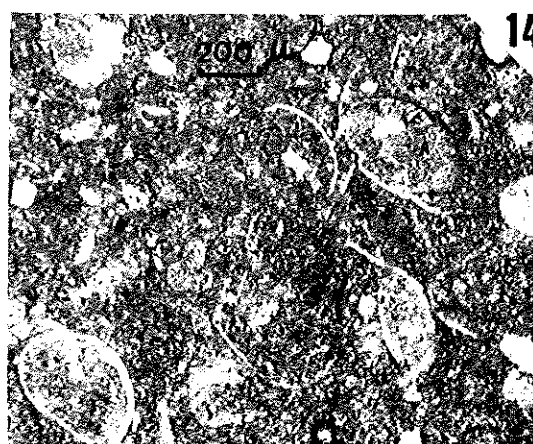
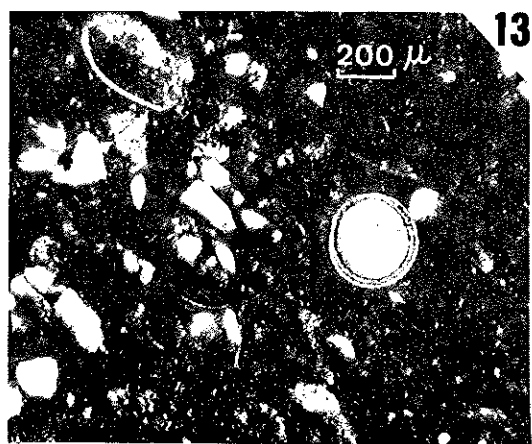


PLATE 29

- Fig. 19. Arenaceous fossiliferous (essentially brachiopods) cryptite. Diagenesis has caused partial recrystallisation of original and still preserved micritic sediment. Comblain-la-Tour Formation, Poulseur Member; intertidal facies. Symbol: C(Q). Poulseur road section. Crossed nicols.
- Fig. 20. Argillaceous, arenaceous and fossiliferous cryptite with rounded intraclast and thick-shelled ostracodes. Local clay concentration (micropsammite). Montfort Formation, Bon-Mariage Member; intertidal to subtidal facies. Symbol: Cy(Pm). Bon-Mariage Quarry. Crossed nicols.
- Fig. 21. Non-fossiliferous calcareous psammakose with poecilitic intergranular (Alizarine Red S dyed) calcite. Comblain-la-Tour Formation; subtidal to infratidal facies. Section is part of a sandy bed of a few centimeters thickness intercalated with other lithologies as clay, limestone, laminated fossiliferous psammakose. Symbol: Q(C). Comblain-la-Tour Quarry. Plain light.
- Fig. 22. Non-fossiliferous arenaceous limestone (sparite). The calcitic matrix consists of well crystallized, somewhat twinned poecilitic grains with embedded detrital particles. Evieux Formation; intertidal facies merging into alluvio-marine facies. Symbol: CA. Souverain-Pré road section. Crossed nicols.
- Fig. 23, 24. Somatite (organoclastite) with poorly sorted and reworked intraclasts (crinoid articles). These show a more or less prominent outer rim of calcite crystals with the same optical orientation as these along parts of the intraclasts, and a central pigmentation or concentration of micrite. The sediment has been recrystallized by diagenesis. The shape of the intraclasts (fig. 23) suggests that they have been reworked before they became sedimented. In fig. 24, some "nests" of detrital material (calcitic psammakose Q(C)) have been made by burrowing organisms. In both photographs, some point-to-point solution can be observed. Comblain-la-Tour Formation; subtidal to infratidal major environment. Symbol: Som. Comblain-la-Tour Quarry. Crossed nicols (fig. 23 dyed with Alizarine Red S to show the shape of the fossils).

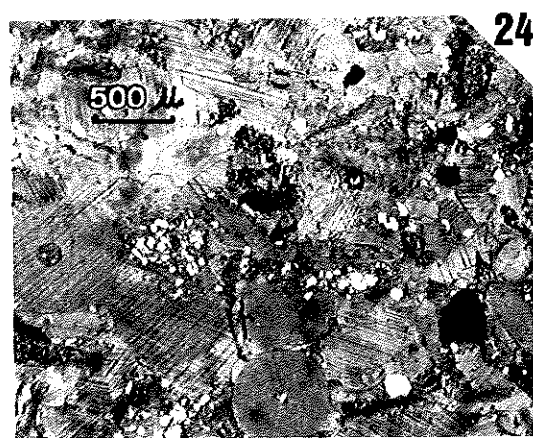
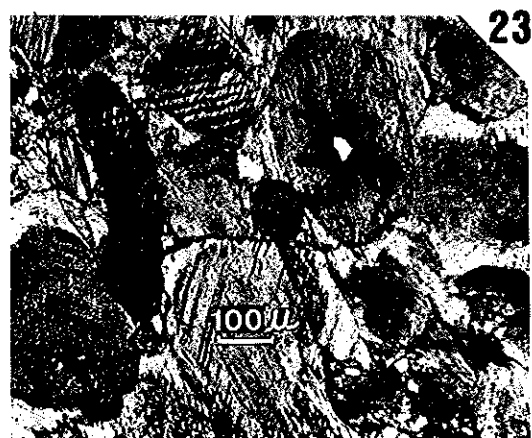
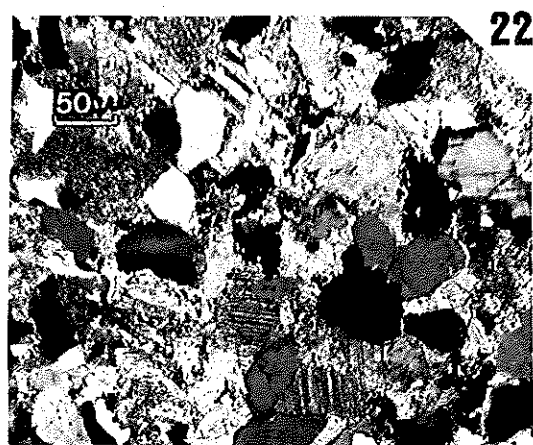
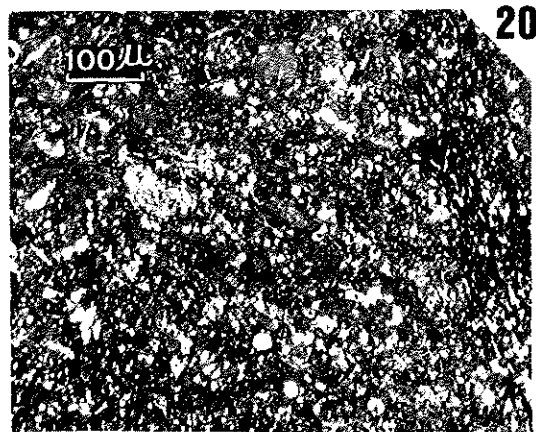


PLATE 30

- Fig. 25. Poorly sorted intraclastic and calcareous psammite. The more argillaceous ground-mass shows some "flux" pattern or fabric. The sediment has been mechanically reworked or disturbed. The intraclasts are irregularly eroded. Some "graded bedding" occurs within the laminae. The clayey matrix is mixed by varying percentages of micrite.
Montfort Formation, Beverire Member; fore-barrier intertidal channel facies. This bed (bed 142) contains reworked conodonts from the *Velifera* zone. The true age of this bed is VUs, which is much younger, according to the spores obtained from the pelitic shales immediately in top of the bed. Apart from the fact, that this is an example of reworked fossils in younger beds, this shows that some epeirogenic movements have taken place at the borders of the basin during the Upper Famennian (THOREZ 1969).
Symbol: Pm(C). Comblain-la-Tour Quarry. Plain light.
- Fig. 26. Fossiliferous calcitic psammite with numerous intraclasts (disarticulated brachiopod shells, crinoid articles). Material is poorly sorted. Intraclasts are concentrated in laminae parallel to the bedding plane as large lenticles in the arenaceous sediment. The small, slightly darker lenticles are clothed micritic calcite, that locally occurs as intergranular cement. They indicate a reworked lateral supratidal sediments, which has been reincorporated in a different, more arenaceous material of a infratidal to subtidal facies.
Comblain-la-Tour Formation; infratidal to subtidal facies.
Symbol: CA. Comblain-la-Tour Quarry. Plain light.
- Fig. 27. Cryptite with abundant organic material and numerous *Umbellinae*, some of them showing well developed "barbs". Where the surrounding sediment of the *Umbellinae* has preserved its original cryptitic lithofacies, the interior of the *Umbellinae* contains a clear hyaline microsporite.
Supratidal, marine environment. This bed occurs immediately above a megaripple of tidal origin.
Symbol: Cy. Montfort IV Quarry. Plain light and Alizarine Red S dyed.
- Fig. 28, 29. Pelmicrite (partially recrystallized into a dismicrite) to fossiliferous (thin-shelled ostracodes) cryptite.
Protected (?) marine environment with tidal influence.
Symbol: Cy. Montfort IV Quarry. Plain light and Alizarine Red S dyed.
- Fig. 30. Recrystallized (sparite) limestone with well preserved thick-shelled ostracodes. In the lower right part of the figure some original micritic material can still be observed.
Symbol: Lrec (recrystallized limestone). Plain light.

